Serial No. _____

INSTRUCTION MANUAL

MODEL 200 AND 300 SERIES SWEEP GENERATOR

WAVETEK

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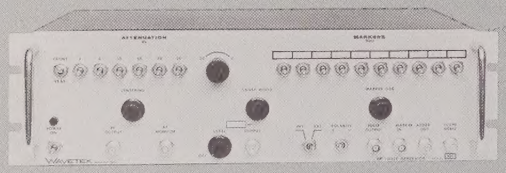
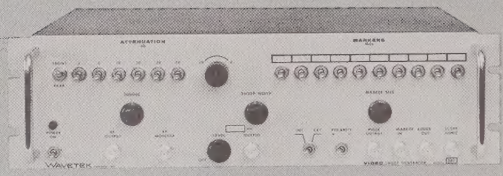
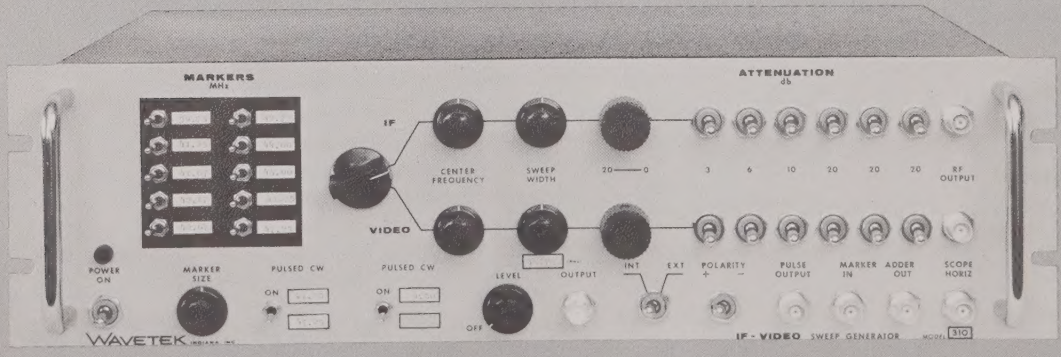


MODEL 301



MODEL 201



MODEL 310

SECTION 1
TECHNICAL CHARACTERISTICS

MODEL 310

The Model 310 is a combination IF-video Sweep generator specifically designed for the test and alignment of monochrome or color TV receivers. Several optional features are available with this instrument to speed production test, eliminate duplicate equipment, and provide more accurate measurements.

The Model 310 is all-solid-state and of modular plug-in construction, utilizing the utmost in reliability and performance. Both the IF and video outputs have independent center-frequency and sweep-width controls, as well as separate output and attenuation systems. This results in a minimum of setup time when switching modes of operation.

The unique marker circuitry is common to both functions since the zero (heterodyne) frequency deriving the video output is at the video carrier of the standards ordered. In this manner the marker pulses (generated on the IF sweep) convert the same as the receiver second detector. For example, the Model 310 markers at 41.25, 42.17 and 45.75 MHz on IF connect respectively to 4.5, 3.58 and 0 MHz on the video, and Model 310-1 markers at 33.4, 34.47 and 38.9 MHz on IF connect to 5.5, 4.43 and 0 MHz on the video. This results in considerable savings over the cost of separate instruments.

MODEL 301

The Model 301 IF Sweep Generator is the IF portion of the Model 310. The crystal-filter marker system provides up to ten extremely sharp and accurate pulse-type indications with individual on-off switches. Five markers are provided in the instrument as standard equipment with an additional five available as an option. The markers may be used to internally modulate (or blank) the sweep signal, or as negative or positive 35-volt pulses. This allows a flexible method of distribution of markers and sweep over single or multiple cable distribution systems.

MODELS 201 AND 202

Models 201 and 202 Video Sweep Generators are the video portion of the Model 310. These instruments present an extremely stable heterodyne sweep signal over a 1000-to-1 range. The center-frequency tuning and sweep width are continuously adjustable.

The Models 201 and 202 accept two marker plug-in modules, each providing up to four crystal-controlled, pulse-type markers at customer-specified frequencies. These markers are independently turned on and off by front-panel switches and may be used internally to blank (modulate) the sweep oscillator and buffer stage, or externally for Z- or Y-axis modulation of the associated oscilloscope. A polarity switch selects either a positive- or negative-going marker pulse for external use.

SPECIFICATIONS

ALL MODELS

DISPLAY LINEARITY	±5% at max sweep width.
RF OUTPUT	1 V rms into 75 Ω.
RF BLANKING	RF output off during sweep retrace.
SCOPE HORIZ	Approx 15 V p-p into 1 MΩ.
SWEEP RATE	AC line frequency 50/60 Hz.
MARKERS	
Type	Pulse.
Accuracy	0.01% of crystal frequency.
Width	Approx 75 μsec.
Amplitude	At least 30 V.
Polarity	Positive or negative.
Presentation	INT-EXT or marker adder.
Max Number	10 including Option A.

Option A—Five Extra Markers

MARKER specifications same as above.

Option B—Trap Adjustment Feature

Frequency Range	Any two frequencies between 33 and 47 MHz.
Frequency Accuracy	0.005% of crystal frequency.
RF Output	0.1—1 V rms into 75 Ω.
Occurance of Pulse	During retrace time only.
Position of Pulse	Anywhere over center 90% of retrace.

CW Base-Line Leakage	60 db below cw pulse.
Interpulse Leakage	Better than 40 db below desired pulse level.
Max Number of Pulses	2 per module, 4 total.

Option C—Sound Trap Adjustment Feature

Frequency Range	41.5 and 46.0 MHz (4.5 MHz), 34.0 and 39.5 MHz (5.5 MHz).

All other specifications the same as Option B.

Option D—CW Output

Frequency Any single frequency between 37 and 48 MHz.

Accuracy	0.005%.
RF Output	3-V peak into 50 Ω.
RF Output Range	25 db minimum.
POWER	115/230 Vac ±10%. 50/60 Hz, approx 15 W.
PHYSICAL	
Size	5¼ in. x 19 in. x 10 in.
Weight	15 lb.

	Models					
	201	**202**	**301**	**301-1**	**310**	**310-1**
IF Frequency Range	----	----	35.5–51.5 MHz	29.15–43.15 MHz	35.5–51.5 MHz	29.15–43.15 MHz
IF Center Frequency	----	----	43.5 MHz	36.15 MHz	43.5 MHz	36.15 MHz
IF Sweep Width	----	----	5–16 MHz	5–14 MHz	5–16 MHz	5–14 MHz
IF Output Flatness	----	----	±0.25 db	Same	Same	Same
IF Output Impedance	----	----	75 Ω	Same	Same	Same
IF Variable Attenuation	----	----	0–20 db	Same	Same	Same
IF Step Attenuation	----	----	3,6,10,20, 20,20 db	Same	Same	Same
Video Frequency Range	1–10 MHz	Same	----	----	Same	Same
Video Sweep Width	2–10 MHz	Same	----	----	Same	Same
Video Output Flatness	±0.5 db	Same	----	----	Same	Same
Video Output Impedance	75 Ω	Same	----	----	Same	Same
Video Variable Attenuation	0–20 db	Same	----	----	Same	Same
Video Step Attenuation	3,6,10,20 20,20 db	Same	----	----	Same	Same

SECTION 2
OPERATING INSTRUCTIONS

MODEL 310 FRONT-PANEL CONTROLS

POWER Switch—Applies ac power. Pilot-light indication provided.

Function Switch—Automatically selects **IF** or **VIDEO** functions, **CENTER FREQUENCY'** and **SWEEP WIDTH**.

RF OUTPUT (IF) Connector—Provides IF output and is normally connected to converter grid or IF input of the TV receiver under test.

RF OUTPUT (VIDEO) Connector—Provides video output and is normally connected to video-amplifier input, chroma-amplifier input, or modulated with the 45.75 MHz carrier for converter grid injection.

CENTER FREQUENCY (IF) Control—Adjusts the mean center frequency from 43.5 +1.0 MHz.

CENTER FREQUENCY (VIDEO) Control—Adjusts the mean center frequency from 100 kHz to 10 MHz.

SCOPE HORIZ Connector—Provides a triangular waveform synchronized with the sweep oscillator. Connected to oscilloscope horizontal amplifier.

ATTENUATION db (IF) Control—Provides 0- to 20-db range of IF output level.

ATTENUATION db (VIDEO) Control—Provides 0- to 20-db range of video output level.

ATTENUATION db (IF) Switches—Reduce the IF output 79 db in steps of 3, 6, 10, 20, 20 and 20 db.

ATTENUATION db (VIDEO) Switches—Reduce the video output 79 db in steps of 3, 6, 10, 20, 20 and 20 db.

MARKERS MHz Switches—Independently select up to ten crystal-controlled pulse-type markers.

MARKER SIZE Control—Adjusts marker amplitude (when using markers externally or through the marker adder), from 0 to over 30 volts.

INT-EXT Switches—Selects internal modulation of the sweep signal by the markers, or presents the markers for external use.

POLARITY Switch—Selects either negative- or positive-going pulses for using markers externally.

PULSE OUTPUT Connector—Supplies external pulses and

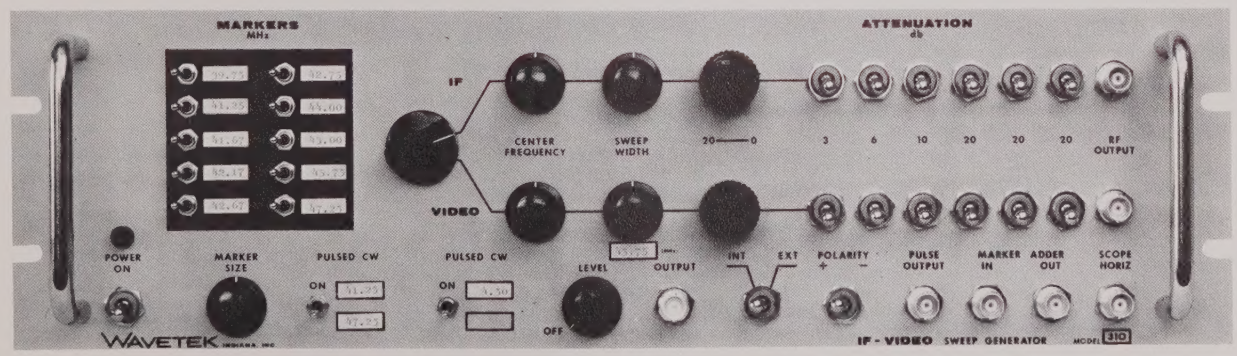


Figure 2-1. Model 310 front-panel control.

can be used for Y- and Z-axis oscilloscope modulation.

MARKER ADDER IN and **OUT** Connectors—Accept demodulated signal, add markers, and supply both to the oscilloscope vertical input.

MODEL 301 FRONT-PANEL CONTROLS

POWER Switch—Applies ac power. Pilot-light indication provided.

RF OUTPUT Connector—Provides the swept RF signal of the sweep generator. A similar BNC jack is on the rear panel. When Options B or C are used, it provides keyed-trap pulses at sweep retrace time.

SCOPE HORIZ Connector—Provides a triangular wave, synchronized with the sweep oscillator, to drive oscilloscope horizontal amplifier. A similar jack is on the rear panel.

FRONT-REAR Switch—Connects sweep oscillator output to either the front or rear output jacks.

CENTERING Control—Adjusts the center frequency of sweep oscillator output. *Clockwise* rotation *lowers* the frequency.

SWEEP WIDTH Control—Adjusts frequency excursion of sweep oscillator. *Clockwise* rotation *increases* sweep width.

ATTENUATION db Control—Provides continuous vernier adjustment of RF output. **Clockwise** rotation produces *maximum* output.

ATTENUATION db Switches—Reduces RF output up to 79 db (in six steps). RF output *maximum* when all the toggles are *down*. These pads will have little effect on keyed-trap pulses.

RF MONITOR Connector—Provides a detected sweep generator output, and is used to observe operation and line VSWR when the sweep generator is the central source of an IF Distribution System.

MHz LEVEL Control—Adjusts the output of Option D (3 V cw source) when provided. *Clockwise* rotation *increases* the RF output. When fully *counterclockwise* signal will be switched off.

MARKERS Switches—Select up to ten pulse markers at frequencies indicated above each switch when toggles are *up*.

INT-EXT Switch—Connects the pulse markers for internal modulation of the RF sweep output in the **INT** position, or to the **PULSE OUTPUT** connector, and **MARKER ADDER** connectors in the **EXT** position. The **MARKER SIZE** and **POLARITY** switch are functional only in the **EXT/MARKER ADDER.**

MARKER SIZE Control—Adjusts the amplitude of the pulse markers at the **PULSE OUTPUT** connector and the **MARKER ADDER** connectors.

POLARITY Switch—Selects either positive or negative marker pulses for the **PULSE OUTPUT** connector and **MARKER ADDER** connectors.

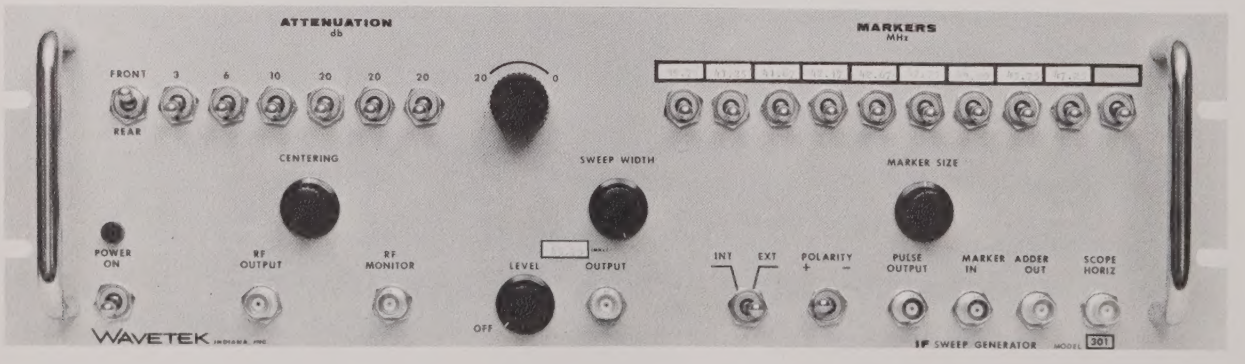


Figure 2-2. Model 301 front-panel control.

PULSE OUTPUT Connector—Provides a positive or negative pulse marker output.

MARKER ADDER IN Connector—Provides a connection for adding differentiated marker pulses to demodulated response from device under test.

MARKER ADDER OUT Connector—Provides a connection for oscilloscope vertical input.

MARKERS Switches—Select up to ten crystal-controlled pulse-type markers.

MARKER SIZE Control—Adjusts marker amplitude (when using markers externally) from 0 to 35 volts.

INT-EXT Switch—Selects internal modulation of the sweep signal by the markers, or presents the markers for external use.

POLARITY Switch—Selects either negative- or positive-going pulses when using markers externally.

PULSE OUTPUT Connector—Supplies external marker pulses and can be used for Y- or Z-axis oscilloscope modulation.

MARKER ADDER Connectors—Accept the demodulated signal, add markers and supply both to the oscilloscope vertical input.

MODEL 201/202 FRONT-PANEL CONTROLS

POWER Switch—Applies ac power. Pilot-light indication provided.

RF OUTPUT Connector—Provides RF output, is normally connected to video or chroma inputs of TV receiver under test.

SWEEP WIDTH Control—Provides adjustment of center frequency excursion from 100 kHz to 10 MHz.

TUNING Control—Adjusts mean center frequency from 100 kHz to 10 MHz.

SCOPE HORIZ Connector—Provides triangular waveform synchronized with the sweep oscillator. Connected to the oscilloscope horizontal amplifier.

ATTENUATION db Control—Provides a 0- to 20-db range of RF output.

ATTENUATION db Switches—Reduce RF output 79 db in steps of 3, 6, 10, 20, 20 and 20 db. An additional switch will present RF output at either front or rear panel BNC jacks.

RF MONITOR Connector—Provides detected output of IF sweep signal for use in monitoring operation.

TEST STATION SETUP

The following procedures are recommended when placing the Models 310, 301, 201 or 202 in operation at a test position.

AC Input Power

The instrument, when shipped from the factory, is wired

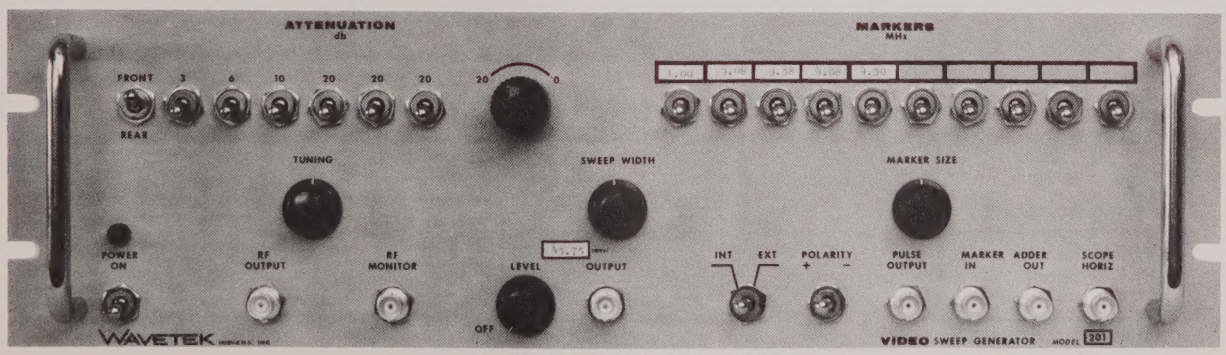


Figure 2-3. Model 201/202 front-panel controls.

for either 115 or 230 volts, 50/60 Hz operation. A red tag, attached to the ac power cord, indicates that the instrument is wired for 230 volts. Note: *DO NOT* plug the instrument into an incorrect power source.

Switch the ac power switch on and construct the test setup as shown in Figure 2-4. Coaxial cables with BNC connectors should be used for proper connection, with minimum hum and spurious signal pick up. It is very important to use *75-ohm* coaxial cable from the RF output connector to the matching network or device under test.

Matching Network

A matching network should be used if the input impedance of the device under test is not identical to the output impedance of the sweep generator (75 ohms). This insures a constant amplitude signal at the input.

RF Detector

An RF detector must be employed between the device under test and the oscilloscope if the device under test does not contain its own detector. The input impedance of this detector should match the output impedance of the device under test. Do not connect the IF output of this instrument directly into any circuit at a point where a dc potential exists. This could result in damage to the output circuits in the instrument. Capacity or inductive coupling must be used when connecting into dc circuits.

Adjust the front-panel controls as follows:

1. **CENTERING** or **TUNING** to center the response on the oscilloscope.
2. **SWEEP WIDTH** to the desired frequency range, depending on the bandpass of the device under test.
3. **ATTENUATION db** to the correct RF input without overdriving the device under test.

Markers

Three methods of presenting markers are provided in these instruments. They may be used to internally blank (shut off) or modulate the RF output (A, Figure 2-5); for Z-axis modulation of the oscilloscope (B and C, Figure 2-5), or added to the demodulated output of the test device or pulse indication (D, Figure 2-5).

Z-Axis Modulation

Connect the **PULSE OUTPUT** of the sweep generator to the oscilloscope Z-axis input (see Figure 2-6). Set the front-panel controls as follows:

1. **INT-EXT** to **EXT.**
2. **POLARITY** for either intensity of blanking modulation.
3. **MARKER SIZE** for the desired marker presentation.

RF Modulation

Set the **INT-EXT** switch on the instrument to **INT.** This is the only adjustment necessary to obtain RF modulation.

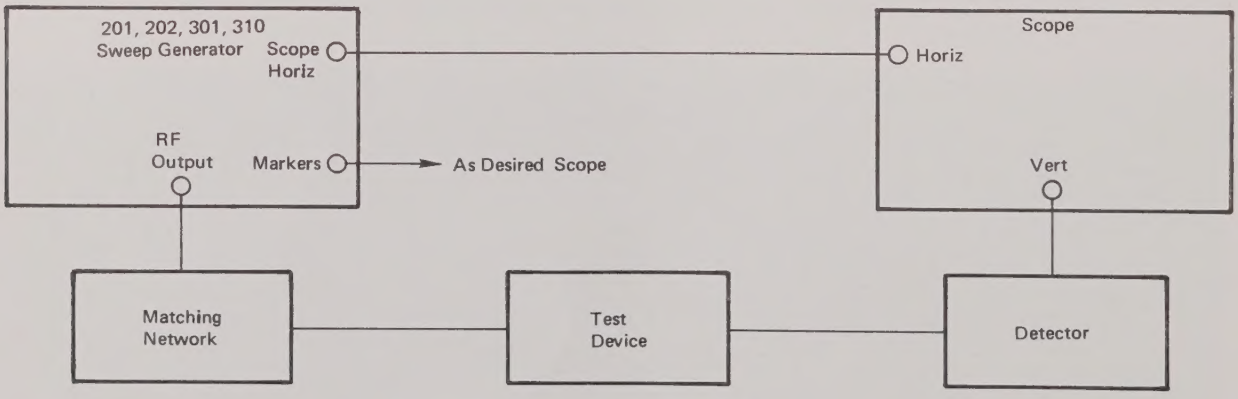


Figure 2-4. Test setup.

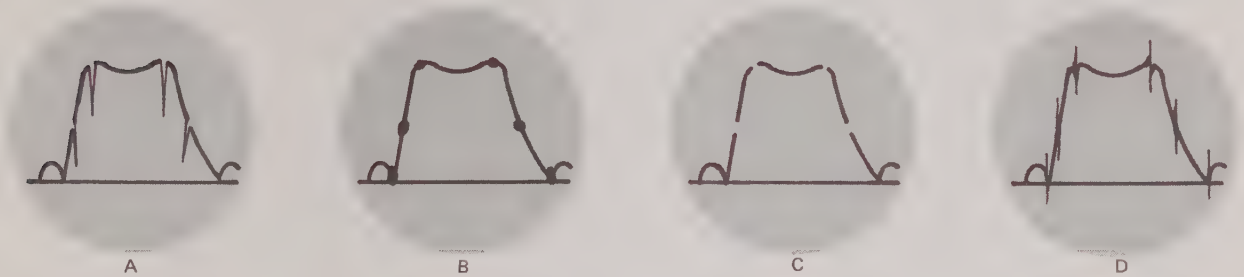


Figure 2-5. Marker display.

Marker Adder

To add markers to scope vertical (D, Figure 2-5), connect as shown in Figure 2-7.

M12A Keyed-Trap Feature

Make the proper IF connections and marker selection. Turn on the trap feature with the front-panel **PULSED CW** switch (Model 310 only). The amount of attenuation inserted indicates the differential in the input level between sweep and trap signals.

The traps in the test device may now be adjusted for a minimum null indication. To measure the trap depth, insert additional attenuation until the passband is the same height as the trap. The amount of rejection may be read directly from the attenuator. *Caution*: The high level of keyed cw may saturate the IF amplifiers causing an incorrect measurement. Attenuation substitution will provide a correlation figure.

The amplitude of each pedestal may be individually adjusted by controls on the top of the M12A or M12B Module. To change position on the base line, the module cover must be removed to gain access to the adjustments. See Section 3.

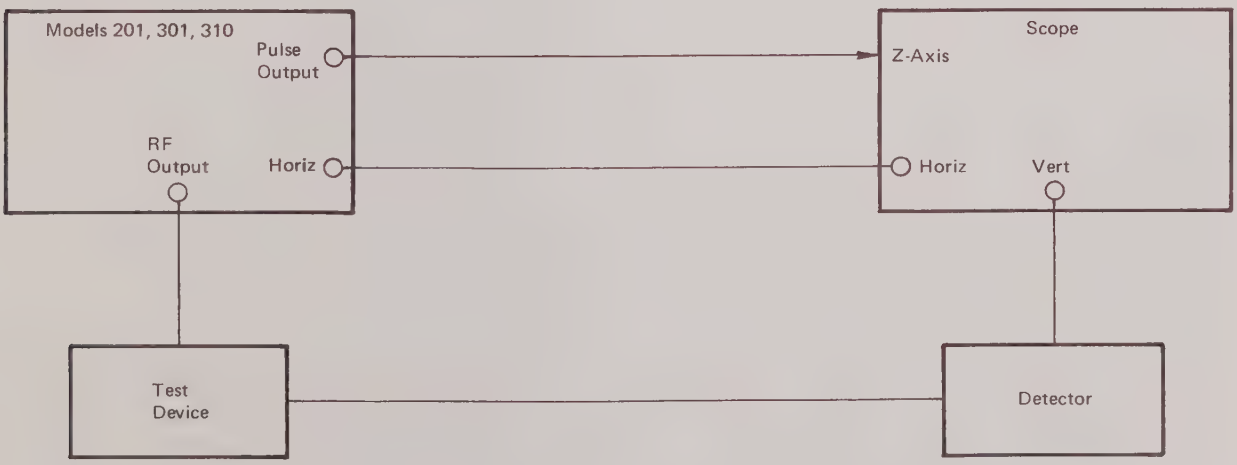


Figure 2-6. Z-axis modulation test setup.

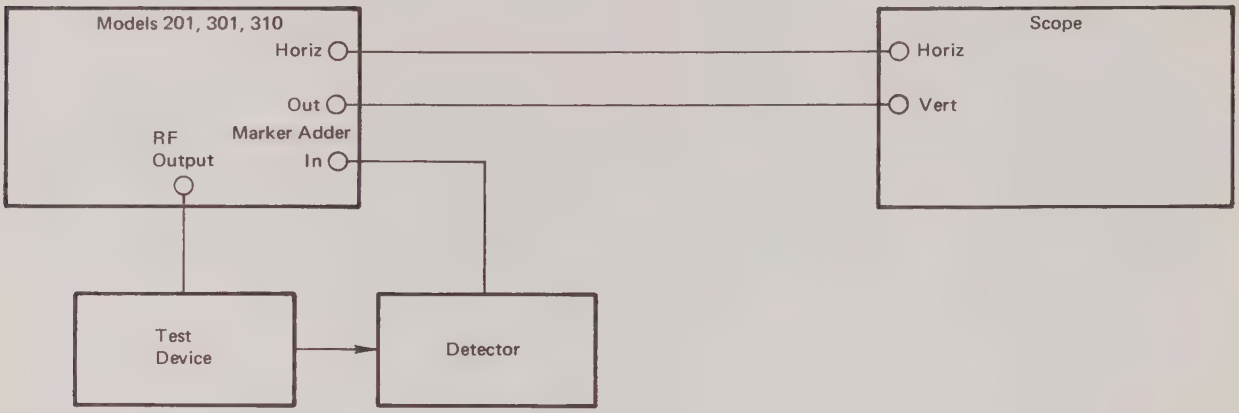


Figure 2-7. Marker adder test setup.

Module M16 for Chroma-IF Modulation

The 45.75 MHz (38.9 on Model 310-1) cw available from Module M16 at the front-panel **CW OUTPUT** connector may be injected into the test device with the IF sweep. The second detector now provides mixing of the 45.75 MHz carrier and the low sideband will pass through the IF amplifier. A signal sufficient for alignment of the chroma amplifier now results.

In operation, a 10:1 differential of sweep-vs-cw is normally used. Or, if the sweep input is 10 mV, the cw should be set to approximately 0.1 V with the front-panel **CW LEVEL** control.

Model 310 Video Output

Make connections as shown in Figure 2-8, except connect to the **VIDEO OUTPUT** connector. If a detector is used, the marker presentations may be as shown in Figure 2-5. If a wideband scope is used instead of a detector, do *not* use the marker-adder method.

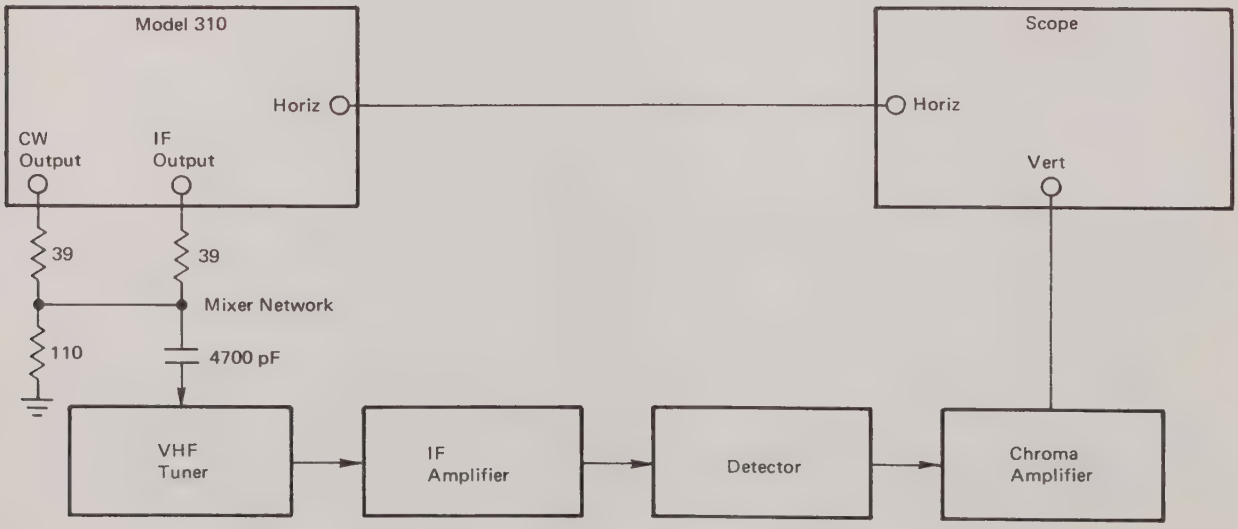


Figure 2-8. Chroma-IF modulation test setup.

Caution: Since markers in video operation are generated from the fundamental IF signal, scope horizontal is reversed by the video function switch for a low-to-high frequency presentation. The trailing edge of the markers are the accurate point, rather than the leading edge as with IF operation. (Model 202 uses leading edge as accurate point.)

Module M16 for Chroma-Video Modulation

For generating a chroma signal with video-sweep injection into the IF section of the TV receiver, use the test setup shown in Figure 2-9. The 45.75 MHz cw output is *mixed* with the video sweep in the sample network and is recovered at the second detector as a video signal.

Sound Trap and Sound Alignment (4.5 and 5.5 MHz)

Connect test setup as shown in Figure 2-10. Use the *look point* as shown. The sound trap may now be nulled.

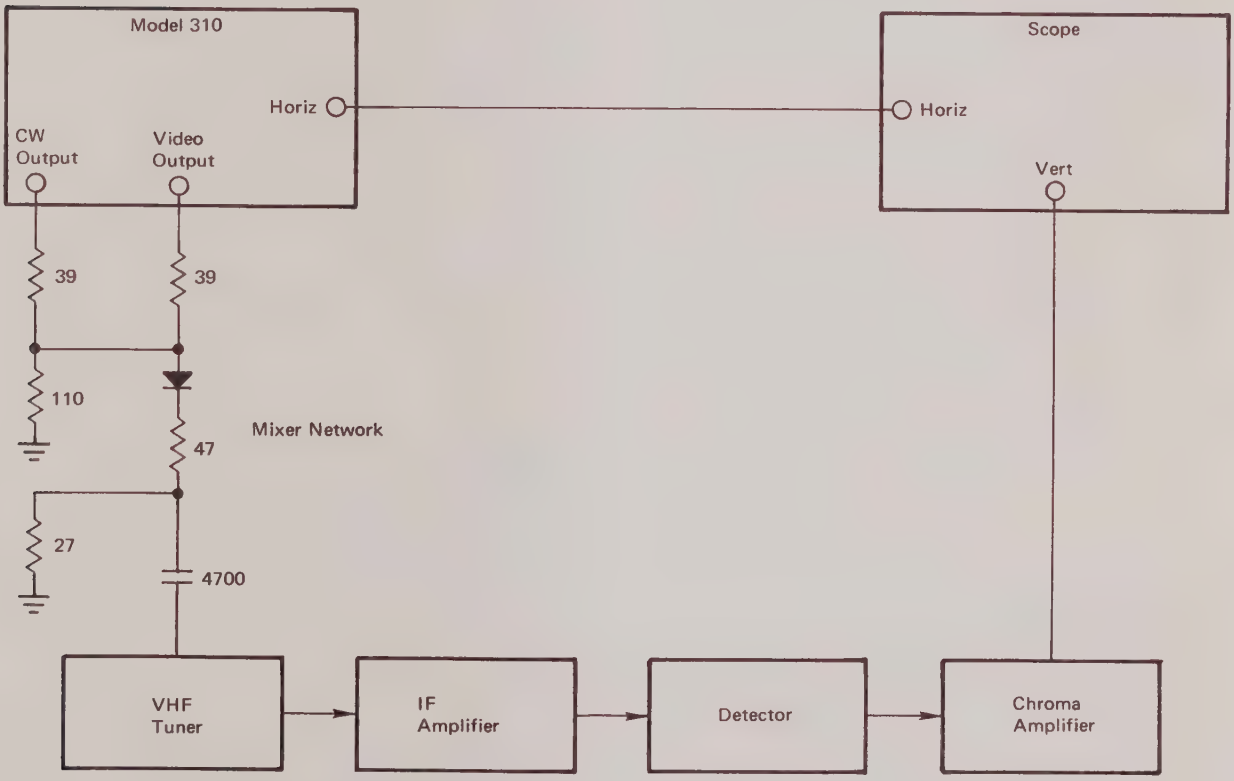


Figure 2-9. Chroma-video modulation test setup.

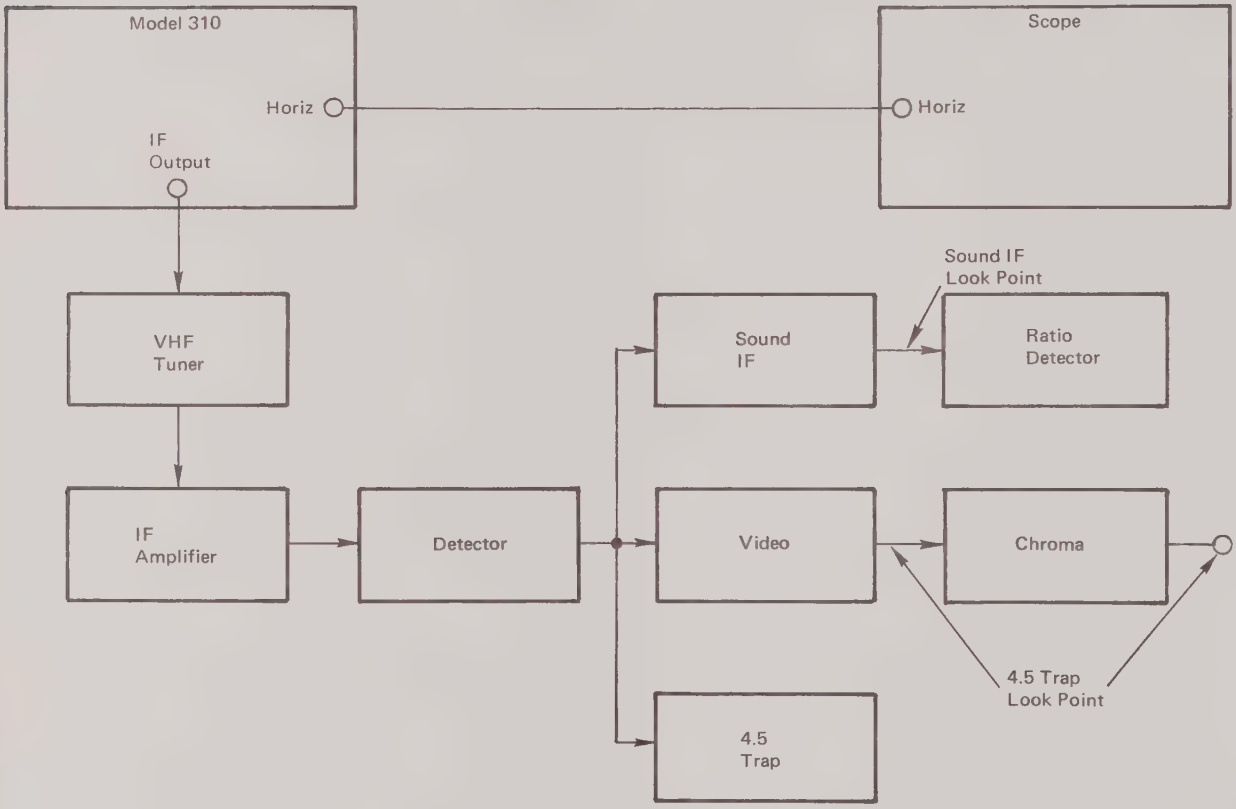


Figure 2-10. Sound trap and sound alignment test setup.

SECTION 3
CALIBRATION

INTRODUCTION

This section contains the information necessary to perform the internal control adjustments and to verify the electrical specifications outlined in Section 1. It is recommended that this calibration procedure be performed every three months to maintain the instrument in proper calibration.

TEST EQUIPMENT REQUIRED

1. Oscilloscope—frequency response dc to 500 kHz. Sensitivity to 1 mV/cm; Hewlett-Packard, Model 130C; Dumont, Model 704, or equivalent.
2. RF Detector—input impedance 75 ohms, frequency response 100 kHz to 300 MHz half-wave peak with negative dc output.
3. Plug-in crystals for Module P13 with test crystals.
4. RF Detector—input impedance 50 ohms, frequency response 100 MHz to 300 MHz peak with negative dc output.

POWER SUPPLY

The power supply performance is verified by measuring the dc output voltage and ac hum levels and comparing them with Table 3-1. The most convenient test points for checking these voltages and waveforms are the plug-in module socket for the P2. The socket pins are numbered from 1 to 12 in a counterclockwise direction. Pins 1, 2 and 3 can be identified by the color of the attached wires, red for pin 1, orange for pin 2, and yellow for pin 3.

Table 3-1. POWER SUPPLY VOLTAGE CHART

Supply Voltage	Test Point	Normal Voltage (Vdc)	AC Ripple (mV p-p)
+180 V	Pin 1 (red wire)	+165 to +195	100
+18 V	Pin 2 (orange wire)	+17 to +19	10
−18 V	Pin 3 (yellow wire)	−17 to −19	10

Prepare the oscilloscope for measuring the power supply voltages by connecting the oscilloscope horizontal input (X input) to the instrument **HORIZ OUTPUT**. Use coaxial cable with BNC connectors. Set the oscilloscope vertical sensitivity to 20 volts per centimeter, dc operation. Set the oscilloscope horizontal sensitivity to 2 volts per centimeter, dc operation.

+180 Volts DC

Connect the oscilloscope vertical input to pin 1 of the P2 socket (red wire attached). Measure this dc voltage and compare with the voltage chart in Table 3-1. There is no adjustment for this voltage. To measure the ac ripple, switch the oscilloscope vertical input to ac and set the oscilloscope vertical sensitivity to 0.1 volt per centimeter. Compare this ripple with the chart.

+18 Volts DC

Set the vertical sensitivity to 2 volts per centimeter, dc operation. Connect the oscilloscope vertical input to pin 2 on P2 socket (orange wire attached). Compare this voltage with the chart. There is no adjustment for this voltage.

To measure the ac ripple, switch the oscilloscope vertical input to ac and set the vertical sensitivity to 0.01 volt per centimeter.

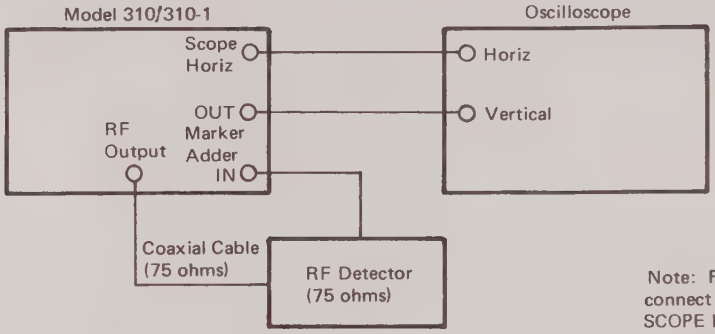
−18 Volts DC

Repeat the procedure for the +18 volts except connect to pin 3 of the P2 socket. It is very *important* that the power supply voltages are within the specifications designated in Table 3-1. Do not continue with this procedure until the power supply voltages are correct. If the voltages are not within the tolerances refer to Section 4.

The remaining procedures are divided into three categories; IF function, video function and optional features. For the Model 310 and 310-1, the entire procedure must be performed; for the Models 201, 202, and 301, only the video function and IF function, respectively, need be performed.

TEST SETUP

Construct the test position shown in Figure 3-1.



Note: For Models 201, 202, and 301 connect instrument RF OUTPUT and SCOPE HORIZ OUTPUT.

Figure 3-1. IF function test position.

Set the front-panel controls as follows:

Models 310 and 310-1

1. **IF-VIDEO** to **IF**.
2. **SWEEP WIDTH** to maximum clockwise position.
3. **CENTER FREQUENCY** to mid position.
4. **ATTENUATION db** all switches in down position (attenuation out); vernier control to maximum clockwise position.
5. **INT-EXT** to **EXT** position.

Models 201, 202, and 301

1. **SWEEP WIDTH** to maximum clockwise position.
2. **TUNING** or **CENTERING** to mid position.
3. **ATTENUATION db** all switches down; vernier control to 0 position.
4. **INT-EXT** to **EXT** position.

IF FUNCTION

RF Output

Calibrate oscilloscope vertical sensitivity to 0.2 volts per centimeter, dc operation. Set oscilloscope horizontal sensitivity to obtain a horizontal display of 10 centimeters.

Adjust the P15 RF LEVEL control (Figure 3-2) for 1.2 volts, peak-detected RF output as indicated in Figure 3-1; this is equal to 1 volt rms.

Frequency Range

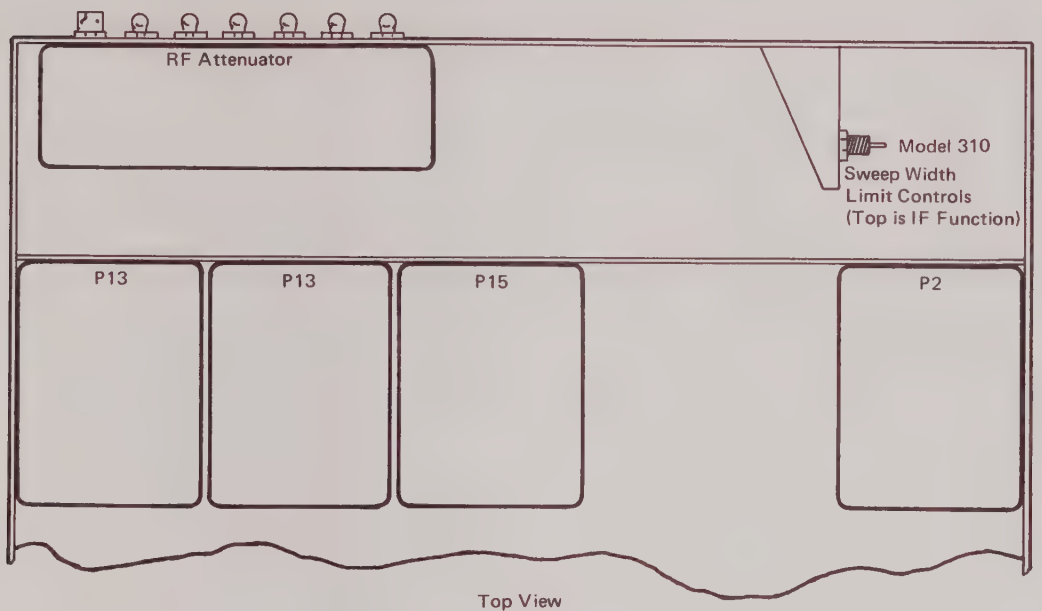
Plug in correct test crystal P13 into one of the P13 sockets on the instrument (Table 3-2) to obtain desired test marker frequencies. If the instrument has both P13 sockets occupied, remove one until calibration is complete. Connect sweep sample cable to the P13 sweep sample input connector. Switch on test markers and adjust the instrument **MARKER SIZE** control for desired marker presentation on the oscilloscope.

Adjust the P2 **CENTERING** control to place the center frequency marker on the oscilloscope center graticule line. The center frequency marker will be 43.5 MHz for USA standards or 36.15 MHz for European standards.

Adjust the **IF SWEEP WIDTH** limit control until the two end markers are on the edge of the oscilloscope display

Table 3-2. P13 TEST CRYSTALS

Model 301 Crystal kit 3-1	Model 301-1 Crystal kit 3-2	Model 310	Model 310-1	Model 201 Crystal kit 2-1	Model 202 Crystal kit 2-2
35.5 MHz	29.15 MHz	Use 301	Use 301-1.	43.75 MHz	47.75 MHz
37.5 MHz	31.15 MHz	and 201		41.75 MHz	49.75 MHz
43.5 MHz	36.15 MHz	crystals.		39.75 MHz	51.75 MHz
49.5 MHz	41.15 MHz			37.75 MHz	53.75 MHz
51.5 MHz	43.15 MHz			35.75 MHz	55.75 MHz



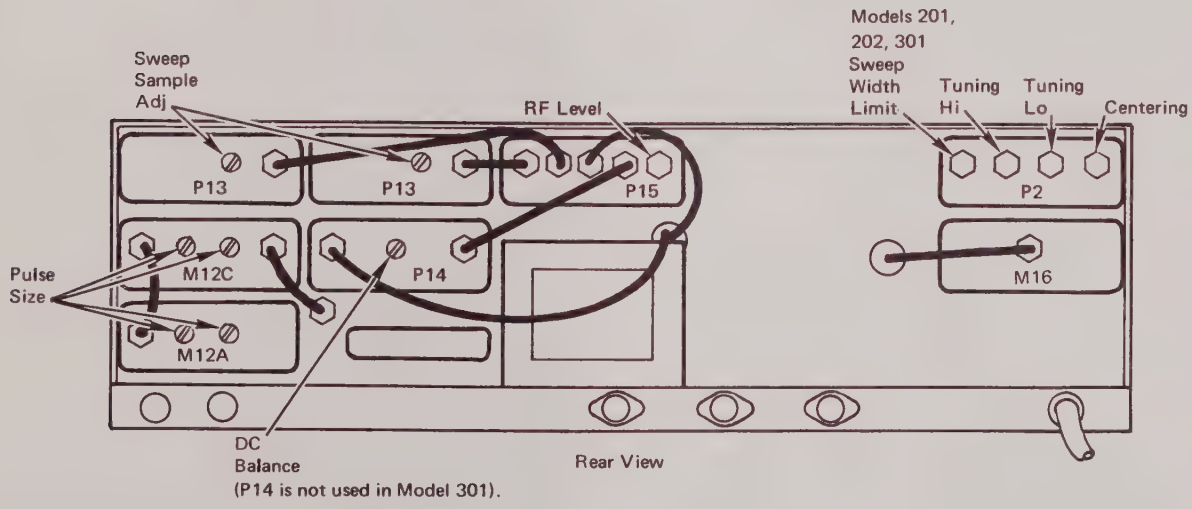


Figure 3-2. Adjustment locations.

(Figure 3-3). It may be necessary to readjust the P2 **CENTERING** control slightly in order to place the two end markers on the edge of the display without excessive sweep width (see Figure 3-3). The center frequency marker may be offset from center slightly.

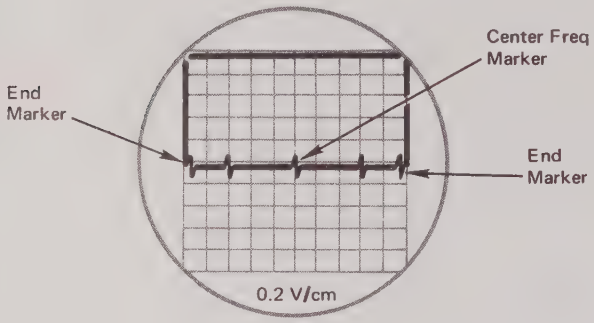


Figure 3-3. Marker locations for IF frequency range.

Display Linearity

The display linearity is a function of the frequency-vs-drive current of the saturable reactor and no adjustments are provided. The display linearity is optimized by the correct selection of average saturable reactor drive current at the factory. Refer to Section 1 for display-linearity specifications. The correct saturable reactor sweep drive current is obtained by the frequency range adjustment.

To measure the display linearity, rotate the instrument **SWEEP WIDTH LIMIT** control to locate the two end markers on the second and ninth graticule line of the oscilloscope scale. (A, Figure 3-4.)

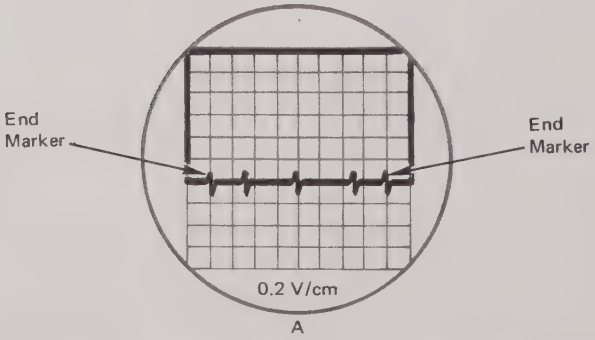


Figure 3-4. Marker locations for IF display linearity.

Next, set oscilloscope horizontal sensitivity control to place the two end markers on the scale (B, Figure 3-4). Measure display linearity by determining displacement of center-frequency marker from center graticule line. Convert this displacement to a percentage of the total horizontal display (10 centimeters). Figure 3-4 indicates a display linearity of five percent. Readjust **SWEEP WIDTH LIMIT** control to its original settings.

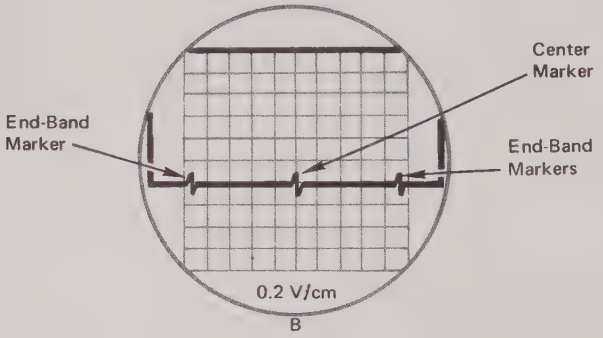


Figure 3-4. Marker locations for IF display linearity.

RF Output Flatness

Switch off RF markers and adjust oscilloscope horizontal sensitivity for approximately 2 centimeters of display. Adjust vertical sensitivity for 10 centimeters of vertical display. (See Figure 3-5.)

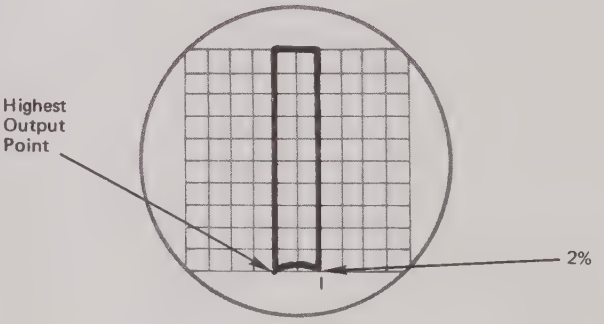


Figure 3-5. RF output flatness.

Set the highest RF output point exactly on the 10-centimeter graticule line and measure the lowest output point. This represents the RF output flatness. Each centimeter is ten percent of the total vertical display. Therefore, the distance between the highest and lowest output point must be five percent (one-half centimeter) or less—this is equal to ±0.5 db. When measuring RF output flatness, it is *very important* that the RF detector and RF input cable be 75-ohm impedance and of good quality.

VIDEO FUNCTION (All Models, except the 301)

Use the test setup in Figure 3-1 except connect the RF detector to the video output attenuator.

Set the instrument front-panel controls as follows:

1. **CENTER FREQUENCY** to the maximum counter-clockwise position.
2. **SWEEP WIDTH** to the maximum clockwise position.
3. **VIDEO ATTENUATION db** all switches down (attenuation out); vernier control to maximum clockwise position.
4. **IF-VIDEO** to **VIDEO**.

Plug correct test crystals into the test P13. Table 3-2 indicates the correct test crystals.

DC Balance

Set oscilloscope vertical sensitivity to 10 millivolts per centimeter scale.

Disconnect the vertical input to the oscilloscope and set the trace on one of the graticule lines. Reconnect the vertical input and adjust the **DC BALANCE** control on the P14 to place the base line on the same graticule line. Set the oscilloscope vertical sensitivity to 0.2 volts per centimeter.

RF Output (Models 201 and 202 only)

Perform the IF, RF output adjustment.

Frequency Range (All models, except 301)

Adjust the P2 **TUNING LO** control until the zero beat is in the center of the oscilloscope. Rotate the instrument front-panel **CENTER FREQUENCY** control to maximum clockwise position. Switch on RF test markers and adjust the P2 **TUNING HI** until the end-band marker is in the center of the oscilloscope. The correct end-band marker is designated in Table 3-2. This must provide a tuning range of 10 MHz. Adjust the instrument **SWEEP WIDTH LIMIT** and front-panel **TUNING** control until the pattern shown in Figure 3-6 is obtained. Check the frequency sweep for 0 to 10 MHz.

Display Linearity (Models 201 and 202 only)

Set the instrument **SWEEP WIDTH LIMIT** and **CENTER FREQUENCY** controls to place the zero and end-band marker on the second and ninth graticule lines of the oscilloscope. (See Figure 3-7 A.)

Adjust the oscilloscope horizontal sensitivity until the zero beat and end-band markers are located as shown in Figure 3-7 B.

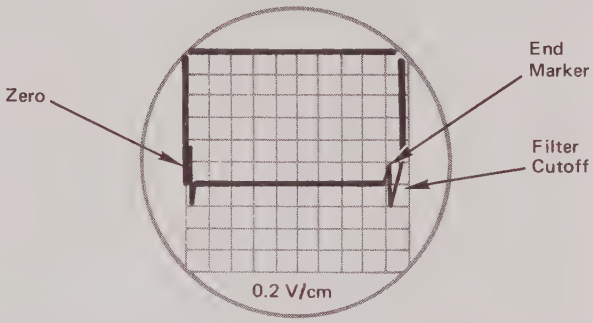


Figure 3-6. Marker location for video frequency range.

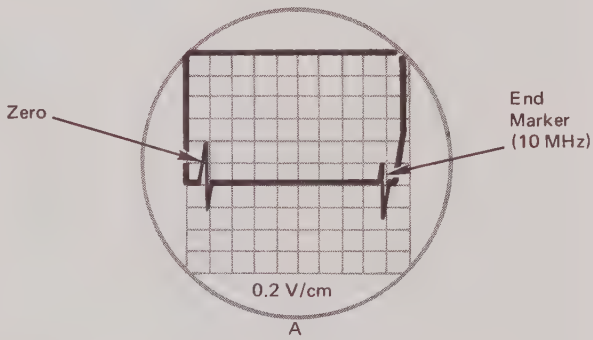


Figure 3-7. Marker locations for video display linearity.

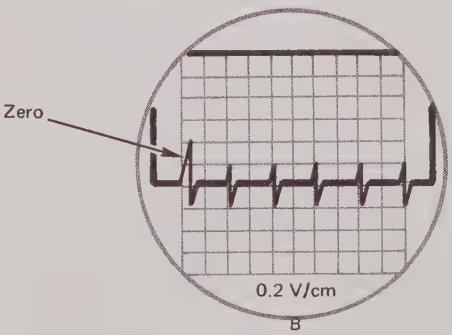


Figure 3-7. Marker locations for video display linearity.

To measure the display linearity, refer to the IF procedures. If the linearity is not within ±5%, adjust the P2 **CENTERING** to obtain the best display linearity and repeat the frequency range procedures. Reset the **SWEEP WIDTH LIMIT** to the original sweep width.

RF Output Flatness (All models, except Models 301 and 301-1)

Refer to the IF, RF Output flatness procedures. Unplug the P13 test module and plug in the original P13 if necessary.

OPTIONAL FEATURES (All models)

Options B and C—IF Trap Feature

Perform the test setup procedure.

Pulse Amplitude

Set the keyed-trap on-off switches to the **ON** position and observe the oscilloscope pattern. The pattern should appear as shown in Figure 3-8. Adjust the **PULSE SIZE** controls (Figure 3-2) until each pulse is 1.2 volts peak output.

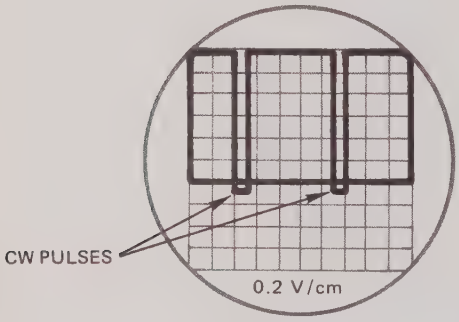


Figure 3-8. Pulse position.

Pulse Position

Remove the M12 covers and adjust R6 position control (see the schematic diagram in Section 10) to locate the pulses on the base line wherever desired.

If the instrument has two trap-feature modules, M12A and M12B, or M12C, adjust the M12B or M12C first and then remove this module and adjust M12A. Replace the module covers and reinstall in the instrument.

Option D—CW Output

Set the oscilloscope vertical sensitivity to 0.5 volts per centimeter and connect the 50-ohm RF detector to the cw **OUTPUT** connector on the front panel. Connect the oscilloscope vertical input to the dc output of the detector. Rotate the instrument **CW LEVEL** control to the maximum clockwise position and measure the oscilloscope vertical deflection. The detected RF should be 3 volts peak or more. Rotate the **LEVEL** control to the maximum counter-clockwise position without turning to the **OFF** position. Measure the detected voltage. The voltage should be less than 10 mV peak.

RF Markers

Set the instrument front-panel marker switches to the **ON** position. Calibrate the oscilloscope vertical sensitivity to 10 volts per centimeter. Connect the oscilloscope vertical input to the instrument **PULSE OUTPUT** connector. Rotate the instrument **MARKER SIZE** control to the maximum clockwise position. Observe the oscilloscope and adjust each P13 **SWEEP SAMPLE ADJUST** until all the markers are present and saturated. See Figure 3-9. Do *not* adjust beyond this point—this can result in spurious markers at lower sweep width.

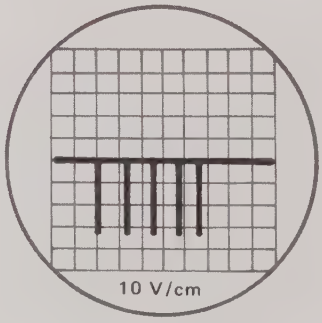


Figure 3-9. RF markers

SECTION 4
MAINTENANCE

PRELIMINARY INSTRUCTIONS

Removal of Dust Covers

The top and bottom dust covers may be removed after loosening eight retaining screws from the side panels.

Module Removal

Modules may be removed from the unit after removing the hold-down screw (Figure 4-1), and any attached cables at the top of the module. When reinserting modules, check the plug-in pins for proper alignment with their associates chassis sockets.

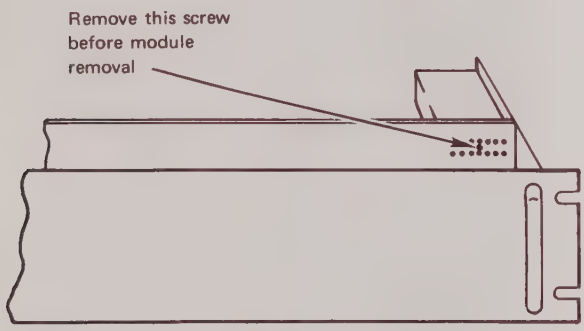


Figure 4-1. Field disassembly.

Module Extension Cable

For troubleshooting the module after removal from the instrument, use module extension cable B 500-170.

115- TO 230-VOLT CONVERSION

The power transformer is supplied with a dual primary which is connected in parallel for 115 Vac and in series for 230 Vac power sources.

First, locate terminal 1, 2 and 3 on the power supply terminal board beneath the power transformer. (See Figure 4-2.) Next, wire the dual primary of the power transformer to terminals 1, 2 and 3 in accordance with the following chart.

Complete the conversion by replacing the fuse with the proper value, ½ amp for 115 Vac or ¼ amp for 230 Vac. A slow-blow fuse should be used.

TROUBLESHOOTING

General

The solid-state design provides a minimum of maintenance problems. However, if problems develop, the plug-in module design should enable complex troubles to be repaired by simple module replacement, thereby providing minimum instrument down-time.

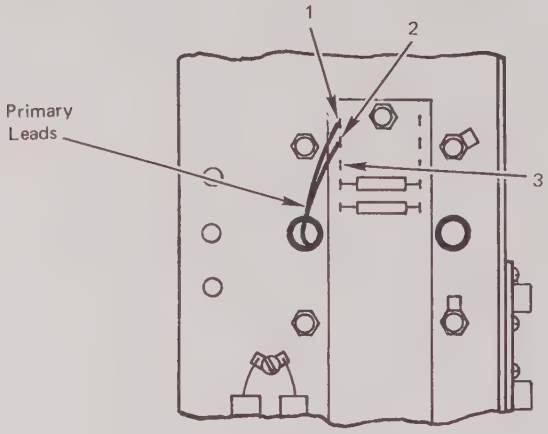
Note: Before proceeding with troubleshooting techniques, the appropriate calibration procedures should be tried, since many troubles can be attributed to maladjustment of the controls.

A careful visual inspection for discolored or damaged parts, defective connections, etc., should also be part of the troubleshooting procedure.

Power Supply

The regulated operating voltages for the sweep generator circuits are +18 volts, −18 volts, and +180 volts. A 27-volt ac 60 Hz sine wave is also supplied from the transformer for line syncronization of the sweep and blanking circuits. The 115 (or 230) volt line power is connected through the **POWER** switch on the front panel. A ½-ampere slow-blow fuse is installed on the line side of the switch.

When switched on, the transformer supplies the necessary ac voltage to two full-wave diode rectifiers and to one half-wave rectifier (180-V supply) on the power supply terminal board. The half-wave rectifier output is smoothed by C11 and regulated through common-base transistor Q11. Zener diodes CR16 and CR17, in series, provide the 180-volt reference. Junction diode CR18 and CR19, shunt-



Term No.	Wire Color 115 Vac	230 Vac
1	Black Brown	Black
2	Blk/Wh Brn/Blk	Brn/Blk
3	None	Blk/Wh Brown

Figure 4-2. Power supply terminals.

ing R12, provide current-limiting protection. I11 is the **POWER** indicating lamp, and R13 reduces the circuit voltage.

The +18-volt supply is series regulated through Q13, with a reference established by the zener diode CR23. R22 and R23, and Q15 provide the error-sensing network establishing the output voltage at +18 as referenced by zener diode CR23. CR14 on the chassis provides output decoupling. Zener diode CR20 provides current overload protection.

The −18-volt supply is identical to the +18-volt supply, except that the output and ground return connections are reversed.

Since a defect in the power supply will affect all circuitry, it should be checked for proper operation before proceeding to other circuits. Use the following power supply specification as a checklist.

Supply	Tolerance	Ripple*	Wire Color
+180 V	±15 V	100 mV	Red
+18 V	±1 V	10 mV	Orange
−18 V	±1 V	10 mV	Yellow
27 Vac			

Note: AC line voltage must be 115 V ±10 V.

*The voltages shown are 60 and 120 Hz power-supply ripple voltages and do not include ripple due to load variations. Load variations stem mainly from the square-wave blanking circuit and the sweep drive circuits. The blanking circuit will introduce a square-wave component to the ±18- volt supplies of approximately 10 mV or less. The sweep drive circuits will introduce a triangular component to the regulated supplies, which disappear when the front-panel **SWEEP WIDTH** control is set for minimum sweep width.

Improper operation of the power supply can be caused by out-of-tolerance line voltage, improper load current, or a defective component in the supply. If improper load current is suspected, the modules can be unplugged, one at a time, until the defective module is found. However, a minimum current of approximately 14 milliamps is required for operation of the ±18-volt supplies. If a defective component in the power supply is suspected, use the power supply schematic (Figure 4-4), Table 4-1, and Figure 4-3.

Module Wiring Diagram

If the power supply is operating properly, refer to the applicable module wiring diagram (Figure 4-5, 4-6 and 4-7). Use these diagrams to isolate the trouble to a particular module or subassembly. Replace the module if possible. If not, refer to the section that contains information on that particular module.

Table 4-1. TROUBLESHOOTING CHART

Symptom	Possible Trouble	Solution
POWER SUPPLY		
+180 measures 270 V.	Shorted transistor Q11.	Replace.
+18 measures 35 V.	Shorted transistor Q12.	Replace.
−18 measures 35 V.	Shorted transistor Q13.	Replace.
+180, +18 or −18 measures low or zero.	Short or low resistance path to ground in the load circuits.	Locate the defective module by removing one at a time.

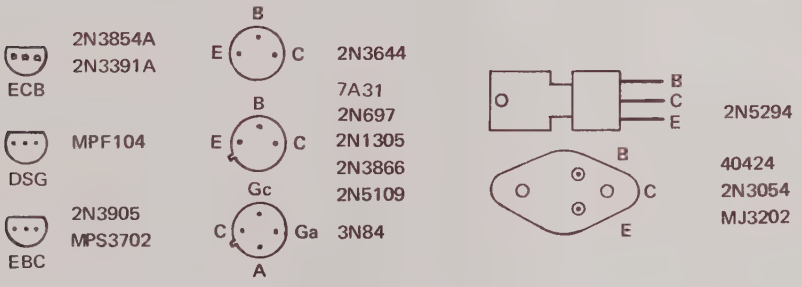
Table 4-1. TROUBLESHOOTING CHART CON'T

Symptom	Possible Trouble	Solution
RF SECTIONS		
No RF output.	Defective RF cables or RF detector.	Replace.
Low RF output.	Defective P15 or maladjusted RF level control.	Replace P15 and perform calibraction procedure.
No video RF output.	Defective P14 module.	Replace.
RF output not flat.	Maladjusted RF level control. Defective RF detector.	Perform calibra- procedure. Replace.
	Monitor diode in the P15 or P14 defective.	Replace.
No sweep width.	Defective P2 module **SWEEP WIDTH LIMIT** control maladjusted.	Perform calibration procedure. Replace.
No RF	No sweep width.	See above.
	Sweep samplemmaladjusted.	Perform calibration procedure.
	Sweep sample cable disconnected or defective.	Connect or replace.
	Defective P13 module.	Replace.

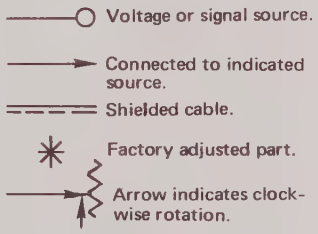
POWER SUPPLY PARTS LIST

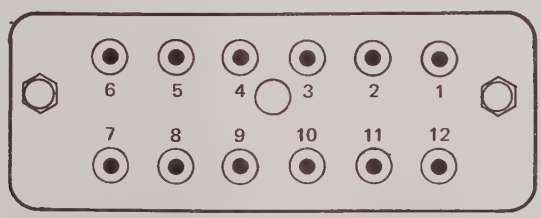
Reference	Description	Part Number
Capacitors		
C11	Electrolytic, 20 μF, 450 V	CE-103-020
C12,C13	Electrolytic, 500 μF, 50 V	CE-102-150
C14,C15	Electrolytic, 100 μF, 25 V	CE-101-110
Diodes		
CR11	Rectifier, 800 PIV, 750 mA	DR-000-002
CR12–15, CR18,CR19 CR16,CR17	Rectifier, 100 PIV, 750 mA Zener, 91 V, ±10%, 1 W	DR-000-001 DB-000-005
CR20,CR22	Zener, 6.8 V, ±10%, 1 W	DB-000-001
CR21,CR23	Zener, 12 V, ±10%, 1 W	DB-000-003
Fuses		
F11	½ amp, slow-blow, 115 V line	MF-000 007
	¼ amp, slow-blow, 230 V line	MF-000-003
Lamps		
I11	Neon, indicator, red	MB-000-001
Resistors		
R11	Comp, 22 k, ±10%, ½ W	RC-106-322
R12	Comp, 33 Ω, ±5%, ¼ W	RC-103-033
R13	Comp, 100 k, ±10%, ½ W	RC-106-410
R14,* R19*	Comp, 470 Ω, ±10%, 1 W	RC-108-147
R15,R20	Comp, 1 k, ±10%, ½ W	RC-106-210
R16,R21	Comp, 12 k, ±10%, ½ W	RC-106-312

TRANSISTOR LEAD CONFIGURATIONS



NOTES AND SYMBOLS





PIN NUMBERS FOR PLUG-IN MODULES

Figure 4-3. Maintenance data.

POWER SUPPLY CON'T

Reference	Description	Part Number
Resistors		
R17,* R22*	Comp, 4.7 k, ±10%, ½ W	RC-106-247
R18,* R23*	Comp, 10 k, ±10%, ½ W	RC-106-310
Switches		
S11	Toggle, DPDT	ST-000-001
Transistors		
Q11	MJ3202 (Motorola)	QB-000-004
Q12,Q13	2N3054	QA-030-540
Q14,Q15	2N3854A	QA-038-541
Transformers		
T11	115/230 V pri, 220 V, 54 V CT, sec	TT-000-004
Miscellaneous		
Power cord	18/3 SVT	WL-002-088
Holder	Fuse	MF-000-004
Insulator	TO-66	HQ-101-002
Washer	Nylon no. 6	HW-110-600

*Factory adjusted value.

CHASSIS PARTS LIST

Reference	Description	Part Number
Standard Modules		
P2	Wave shaper	P2
P13	Markers	P13
P14	Video amplifier	P14
P15	RF oscillator-leveler	P15
Optional Modules		
P13B	Option A, additional markers	P13B

CHASSIS CON'T

Reference	Description	Part Number
Optional Modules		
M12A	Option B, pulsed RF, cw source	M12A
M12B	Additonal Option B	M12B
M12D	Option C, pulsed cw (without Option B)	M12D
M12C	Option C, pulsed cw (with Option B)	M12C
M16	Option D, RF cw source	M16
Subassemblies		
A413	Attenuator	A413
	Attenuator (used with Options B and C)	A413-1
Cable Assemblies		
A1	75 Ω miniature, 14 in. long	WX 301-A1
A2	75 Ω, miniature 4-3/4 in. long	WX 301-A2
A3	75 Ω, miniature, 17½ in. long	WX-301-A3
A4	50 Ω, miniature, 3½ in. long	WX 201-A4
A5	50 Ω, miniature, 6½ in. long	WX 301-A5
A6	50 Ω, miniature, 3½ in. long	WX 301-A6
A7	50 Ω, miniature, 14½ in. long	WX 301-A7
A8	75 Ω, miniature, 15½ in. long	WX 301-A8
Capacitors		
C101	Ceramic disc, 47 pF, 5%, 1 kV	CD 104-047
Connectors		
J101–J105	UG 911 A/U	JB-109-111
J106	UG 909/U	JB-109-090
Resistors		
R101,R102	Carb, variable, 100 k, ½ W	RP-102-410
R103	Carb, variable, 25 k, ½ W	RP-102-325
R104	Comp, 47 k, ±10%, ¼ W	RC-102-347
R105	Carb, variable, 10 k, ½ W, with switch	RP-119-310
Switches		
S101–S110	Toggle, SPST	ST-000-002
S111,S112	Toggle, DPDT	ST-000-001
Miscellaneous		
Knob	0.905 in. diam, black	KK-000-004
Knob	15/16 in. diam, black	KK-000-002
Pin socket		MC-000-002

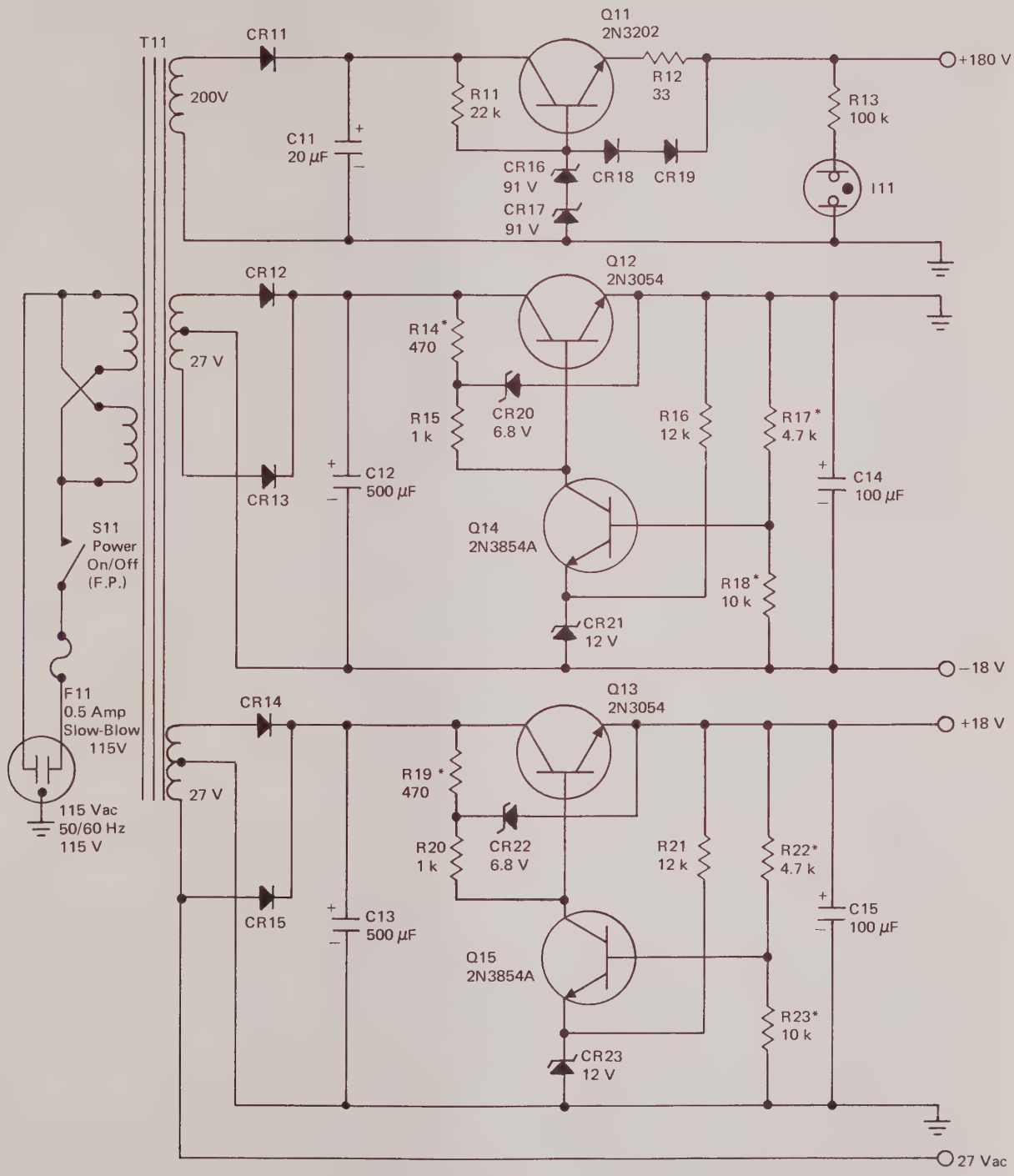
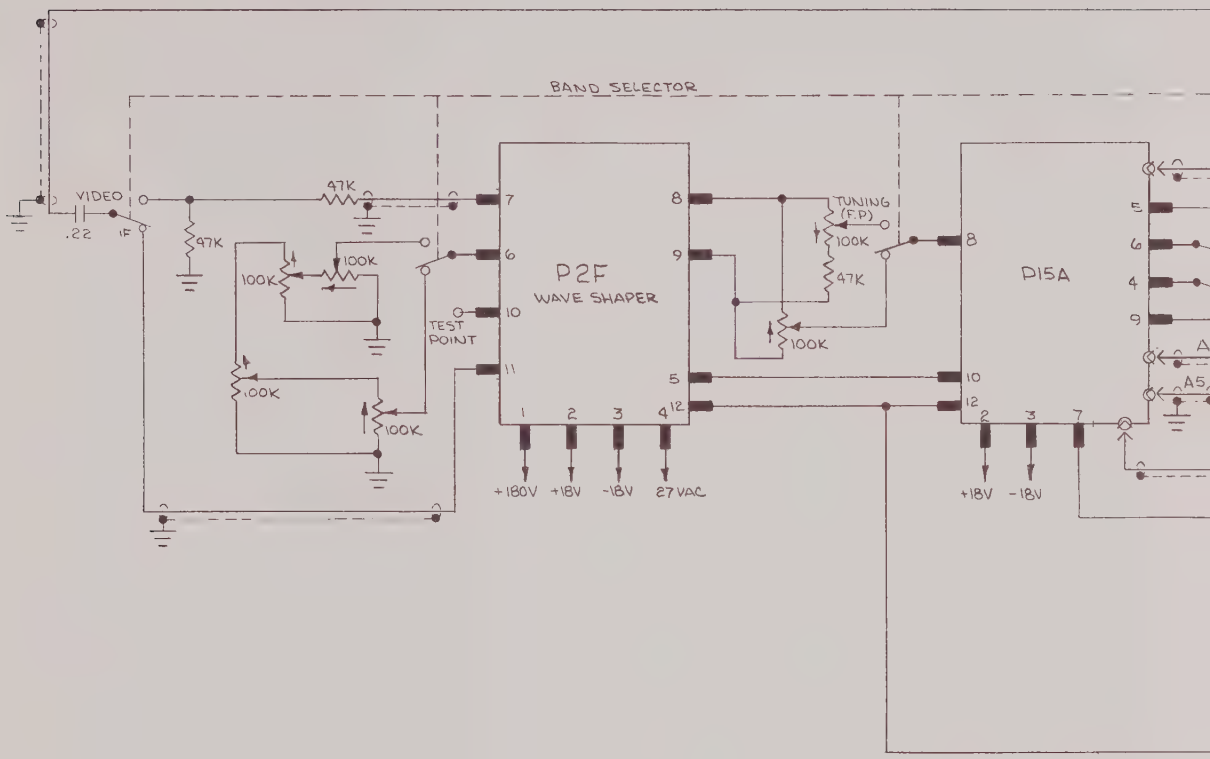


Figure 4-4. Power supply schematic diagram.


BAND SELECTOR
VIDEO
.22
1F
47K
47K
100K
100K
100K
100K
TEST POINT
P2F
WAVE SHAPER
7
6
10
11
8
9
5
1
2
3
4
12
+180V
+18V
-18V
27VAC
TUNING (F.P.)
100K
47K
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-18V
5
6
4
9
A5

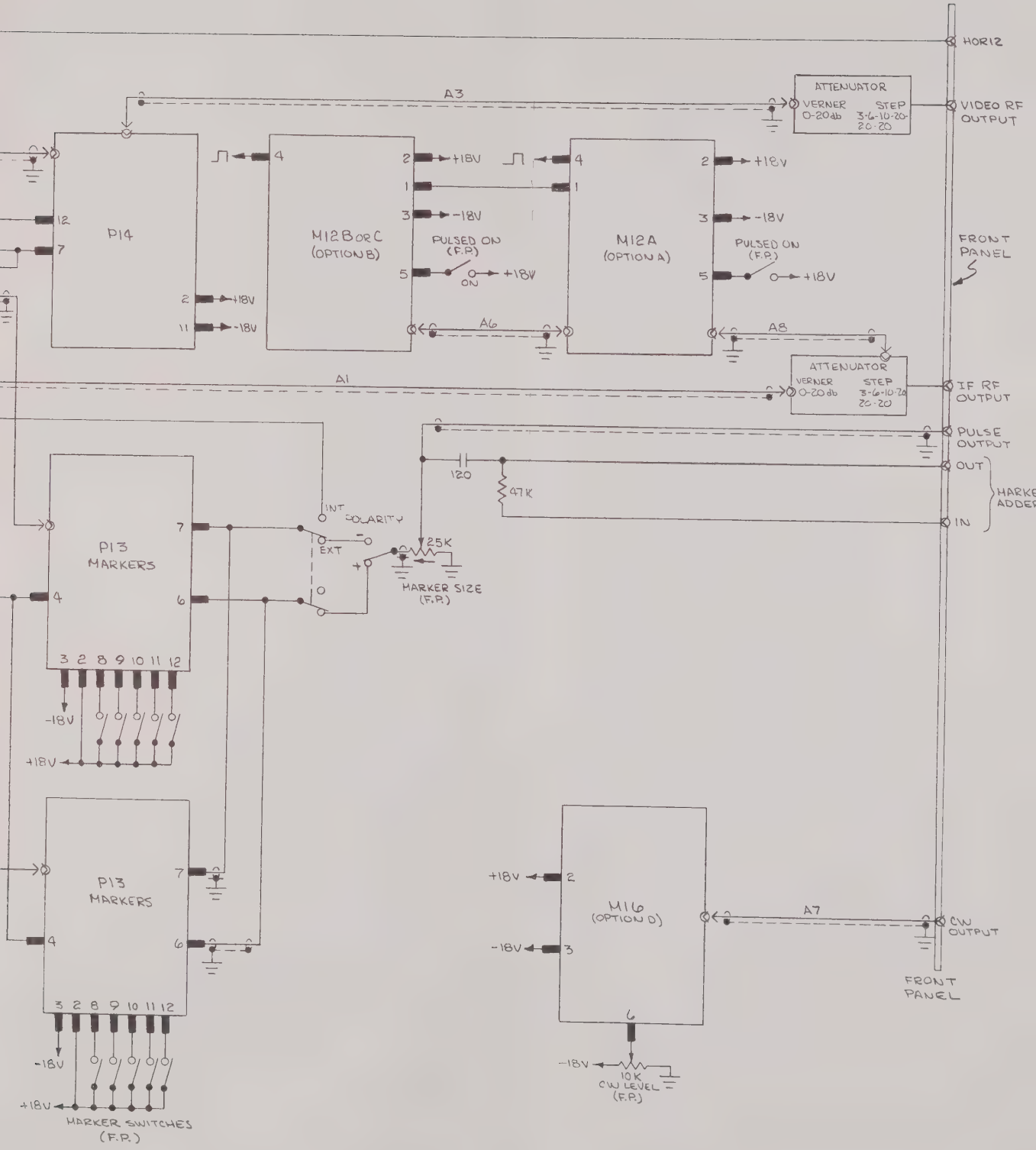
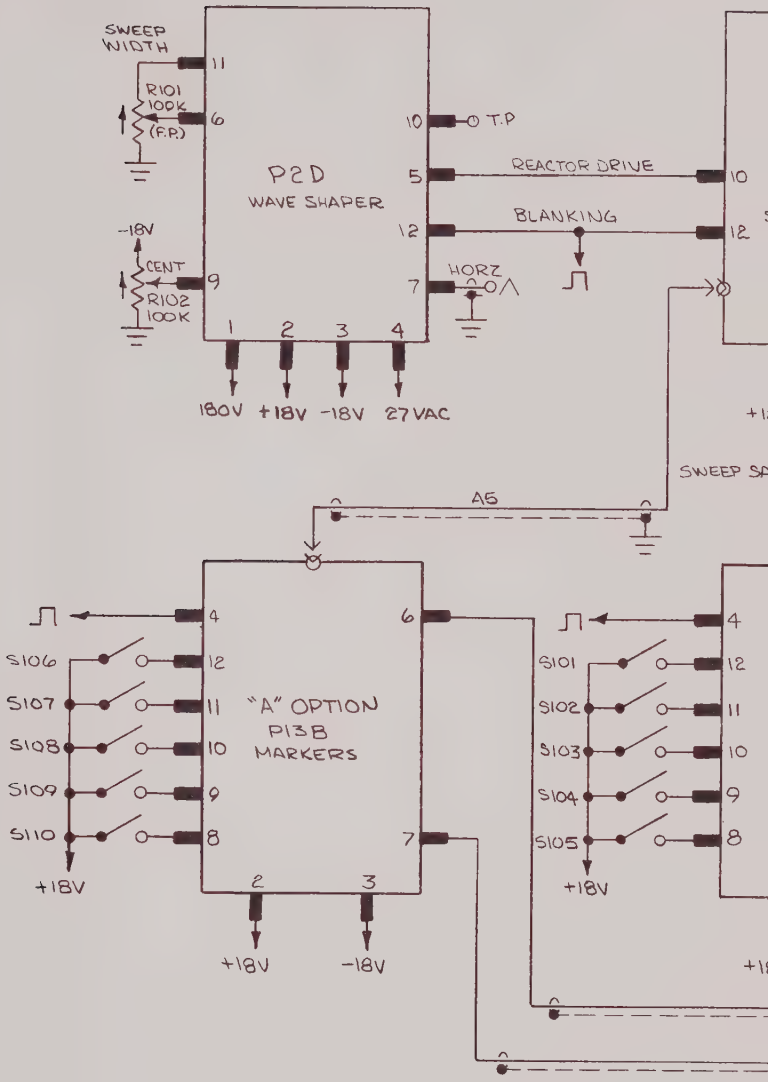


Figure 4-5. Model 310 module wiring diagram


SWEEP WIDTH
R101 100K (F.P.)
-18V
CENT
R102 100K
P2D
WAVE SHAPER
T.P
REACTOR DRIVE
BLANKING
HORZ
180V
+18V
-18V
27VAC
A5
SWEEP SA
S106
S107
S108
S109
S110
+18V
"A" OPTION
P13B
MARKERS
+18V
-18V
S101
S102
S103
S104
S105
+18V

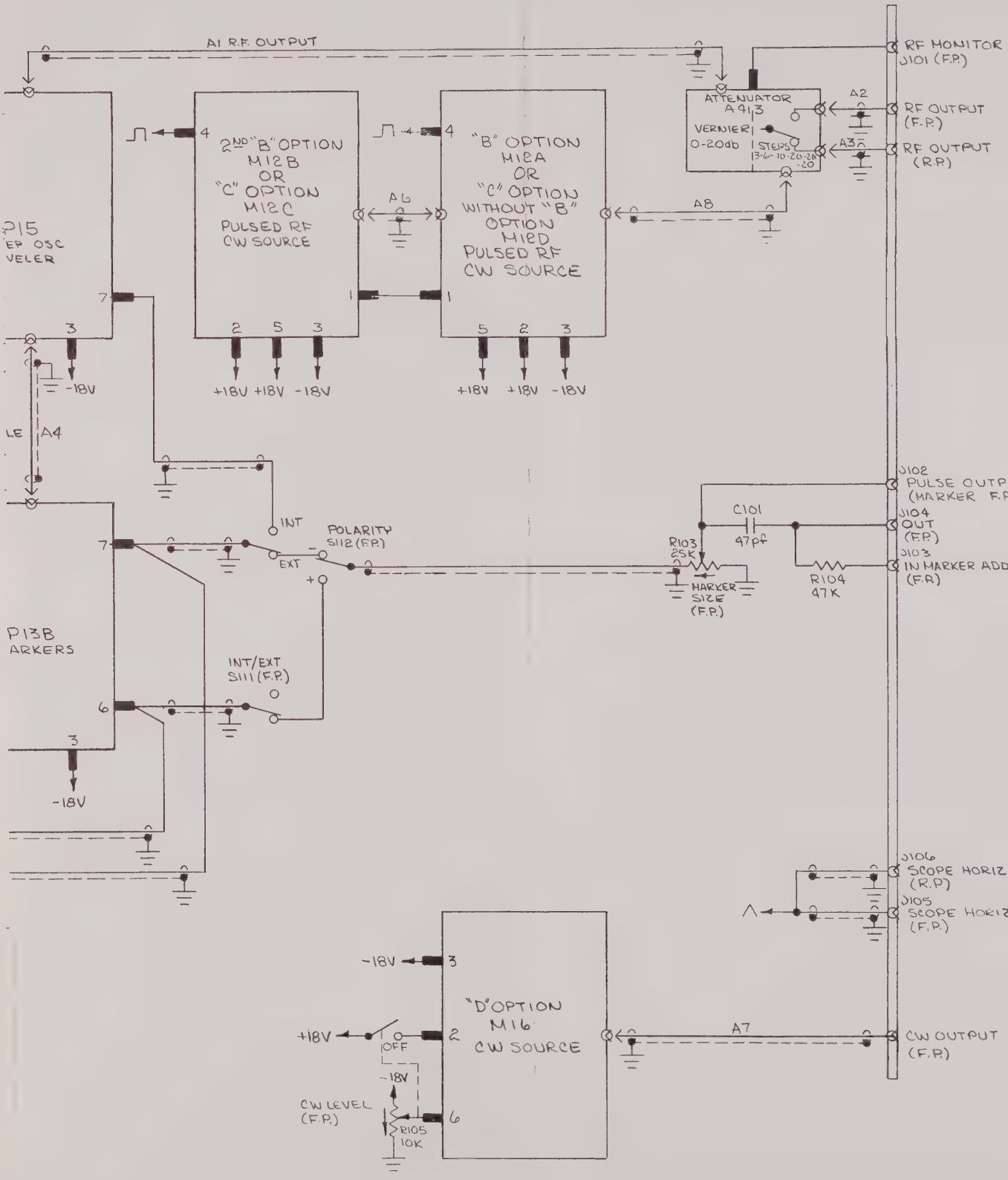
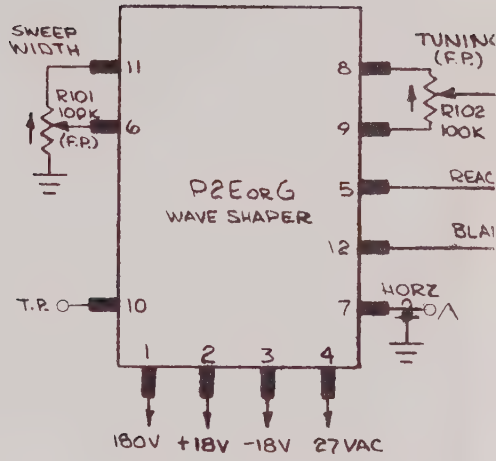
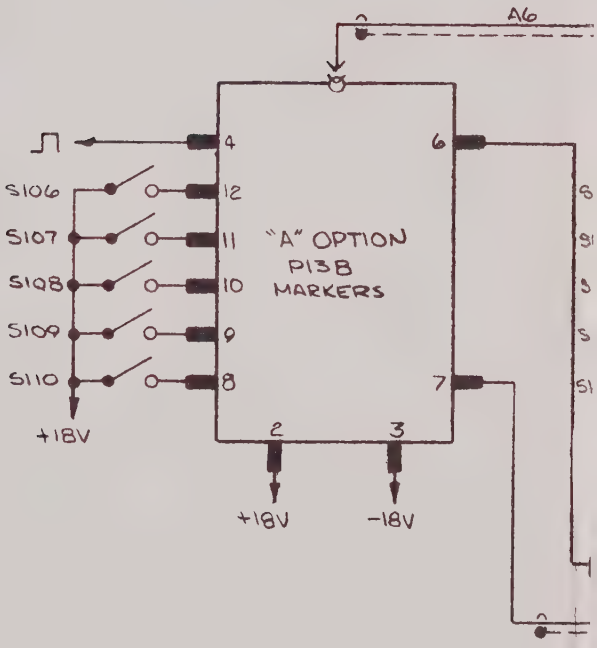


Figure 4-6. Model 301 module wiring diagra


SWEEP WIDTH
R101 100K (F.P.)
TUNING (F.P.)
R102 100K
P2E or G
WAVE SHAPER
REAC
BLA
T.P.
HORZ
11
8
6
9
5
12
10
7
1
2
3
4
180V
+18V
-18V
27VAC


A6
S106
S107
S108
S109
S110
"A" OPTION
P13B
MARKERS
4
12
11
10
9
8
6
7
2
3
+18V
+18V
-18V

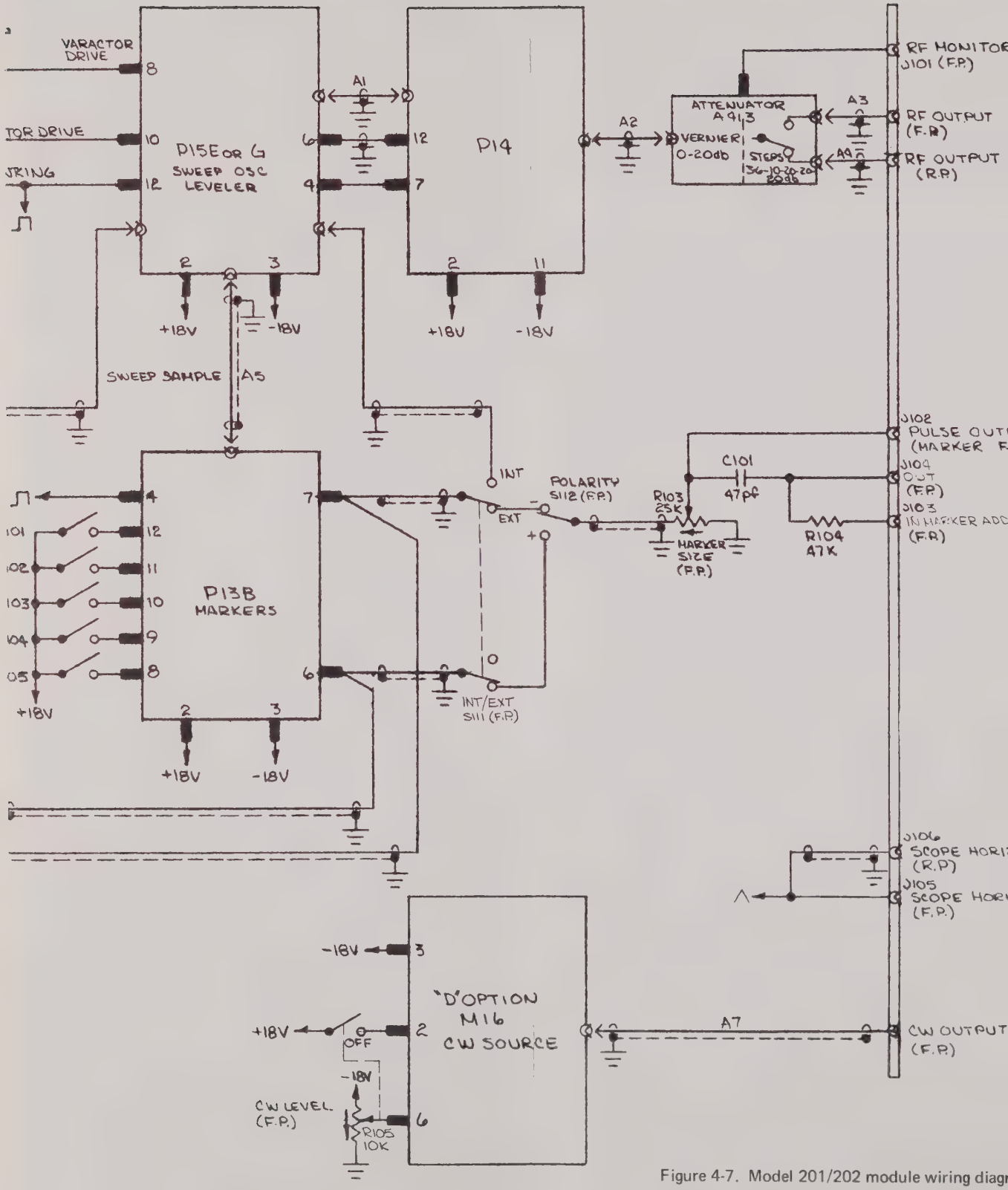


Figure 4-7. Model 201/202 module wiring diagr

SECTION 5
RF ATTENUATOR A408/A413

INTRODUCTION

RF Attenuator A408 and A408-1 (Figure 5-1) or A413 and 413-1 (Figure 5-2) combine a 0 to 20 db pi-pad vernier with a pi-pad step attenuator to give continuous adjustment of RF level over a 99-db range. The A408-1 and A413-1 feature a PIN diode switch for adding additional RF signals, while bypassing the attenuator. Attenuator A408 or A408-1 is used with the Model 310 RF Sweep Generator. RF Attenuator A413 or 413-1 is used with Model 201, 202 and 301.

SPECIFICATIONS

ATTENUATION

Vernier	0 to 20 db.
Step	3, 6, 10, 20, 20 and 20 db.
IMPEDANCE	75 ohm.
FREQUENCY RANGE	0 to 250 MHz.

DIODE SWITCH—The (—1) version includes a diode switch, for adding additional RF signals to the RF output. Signals added at this point bypass the vernier and step attenuators.

DIODE SWITCH—The (—1) version includes a diode switch, additional RF signals to the RF output. Signals added at this bypass the vernier and step attenuators.

MONITOR—RF Attenuator A413/413-1 includes a negative diode detector connected at the output of the vernier attenuator, which may be used to monitor the RF output at this point, or to make VSWR measurements.

MAINTENANCE

Since the three vernier pi-pad resistive carbon wafers can become noisy, applying carbon tetrachloride or other cleaning solution commercially available for use as contact cleaners, will return the wafers to their normal condition.

The attenuation toggle switches are self-cleaning, double wiping units, but the snap spring may fail after continous use. To replace switches proceed as follows: 1. remove attenuator from the unit, lid from the attenuator, and nuts securing the seven switches to attenuator box. 2. Unsolder input and output leads from vernier attenuator, RF output jack, and (—1) feature (if present). 3. The switch mounting plate, with switches, may now be removed from attenuator box and the defective switch replaced.

MODELS A408 AND A408-1 PARTS LIST

Reference	Description	Part Number
Assemblies		
20—0	75 Ω vernier	B500-054

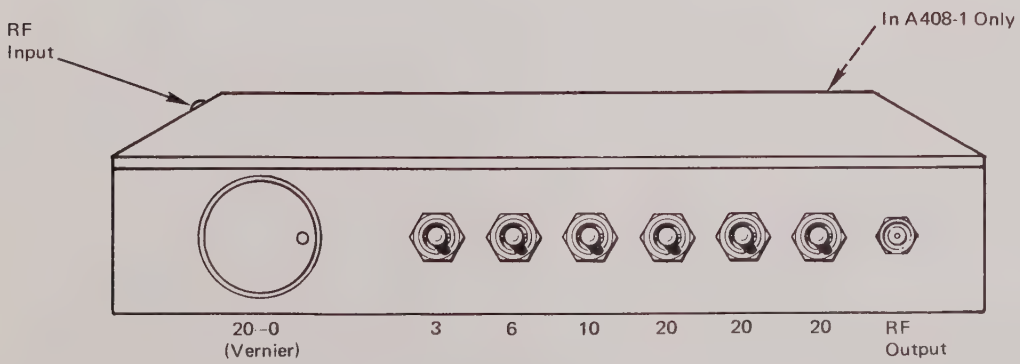


Figure 5-1. Models A408 and A408-1.

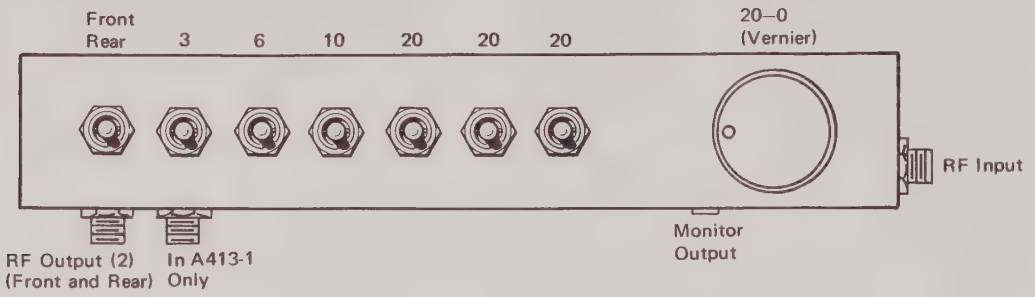


Figure 5-2. Models A413 and A413-1.

A408/A408-1 PARTS LIST

Reference	Description	Part Number
Connectors		
J1,J3*	Jack, 75 Ω	JF100-004
J2	Jack, BNC	JB109-110
Diodes		
CR1*	Si, PIN	DP000-040
Inductors		
L1*	Fixed 2.2 μH	LA001-R22
a 3 db	26.4	RC200-264
b	438	RC201-438

A408/A408-1 CON'T

Reference	Description	Part Number
Resistors		
a 6 db	56.0	RC200-560
b	226	RC201-226
a 10 db	107	RC201-107
b	144	RC201-144
a 20 db	371	RC201-371
b	91.6	RC200-916
Switches		
S1 to S6	DPDT	ST000-001

*Parts contained in A408-1 only.

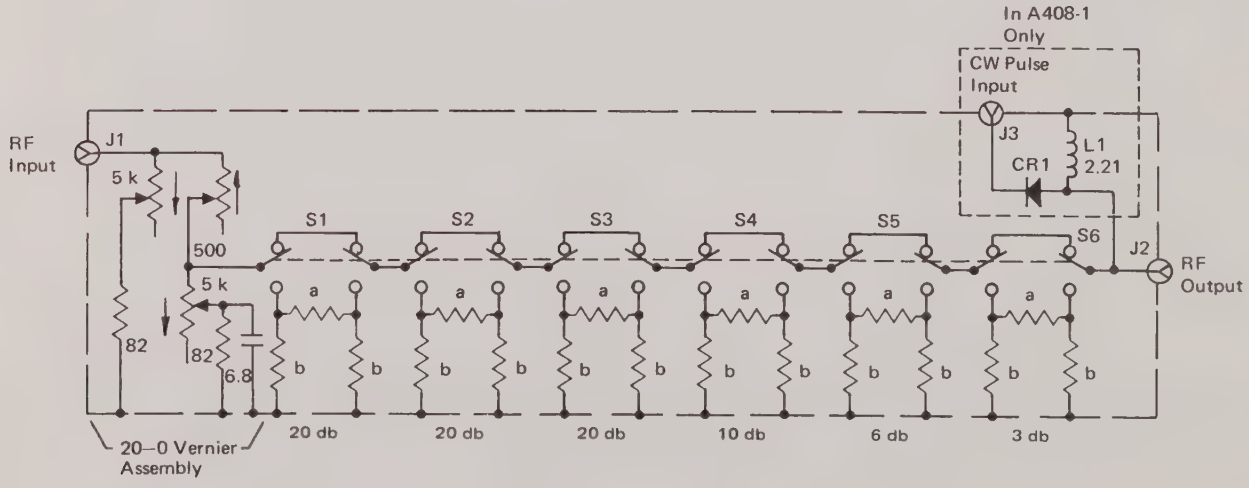


Figure 5-3. Models A408 and A408-1 schematic diagram.

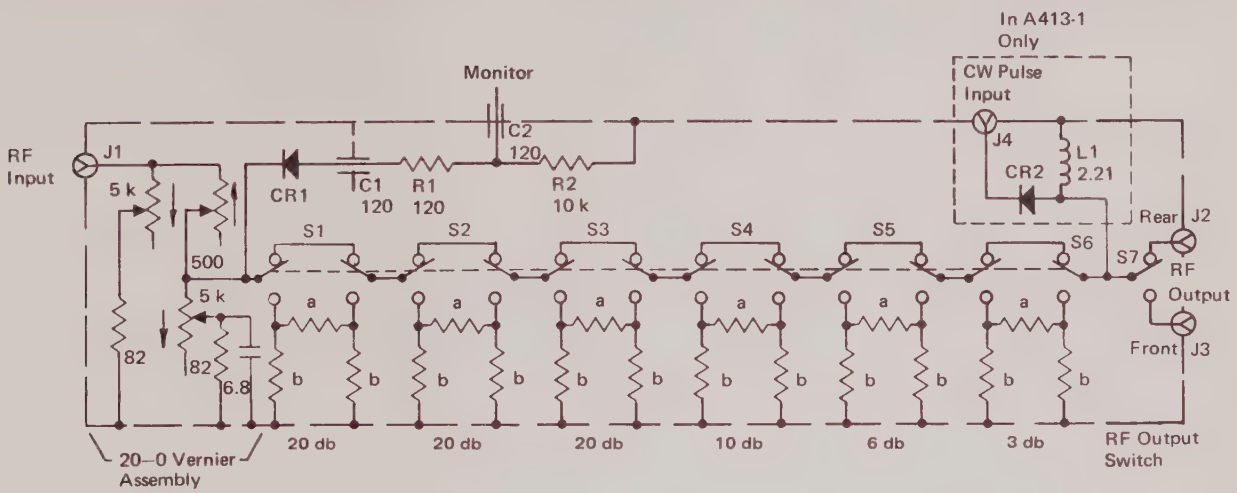


Figure 5-4. Models A413 and A413-1 schematic diagram.

A413/A413-1 PARTS LIST

Reference	Description	Part Number
Assemblies		
20-0	75 ohm vernier	B-500054
Capacitors		
C1	Standoff, 120 pF	CF103112
C2	Feedthru, 120 pF	CF102112
Connectors		
J1–J4*	Jack, recep, 75 ohm	JF100004
Diodes		
CR1	1N34AS	DG100341
CR2*	Si PIN	DP000040
Inductors		
L1*	Fixed, 2.2 μH	LA001R22

A413, A413-1 CON'T

Reference	Description	Part Number
Resistors		
R1	120 ohm ±10%, ¼ W	RC104112
R2	10 k, ±10%, ¼W	RC104310
a 3db	26.4	RC200264
b	438	RC201438
a 6	56.0	RC200560
b	226	RC201226
a 10	107	RC201107
b	144	RC201144
a 20	371	RC201371
b	91.6	RC200916
Switches		
S1–S7	DPDT	ST000001

*Parts contained in A413-1 only.

SECTION 6
MODULE P15 SWEEP OSCILLATOR

INTRODUCTION

The P15 plug-in module provides the RF sweep output to the instrument front panel and supplies sweep signals to other modules in the instrument, such as P13 and P14. Different version of the P15 are designated by suffix letters and explained wherever required.

CIRCUIT DESCRIPTION

The sweep oscillator plug-in module P15 is comprised of the basic circuits shown in the block diagram of Figure 6-1. Suffix letters are used to designate different versions of the basic P15 module. These versions are necessary to make the module compatible with a number of instruments. The differences in the models are clearly indicated on the block diagram.

Sweep Oscillator

The RF sweep oscillator consists of transistors Q13 and Q14 and the associated tuning and decoupling networks. The oscillator is connected in a push-pull circuit with feedback cross coupled by capacitors C15 and C16. Frequency sweeping is accomplished by the saturable reactor connected between the two transistor collectors. The sweep drive current is supplied by plug-in module P2 and routed to the saturable reactor drive winding through C11. This varying current changes the inductance of the oscillator resonant circuit, therefore sweeping the frequency. Control of the sweep drive current is provided by the front-panel **SWEEP WIDTH** control. The oscillator center frequency (frequency at minimum sweep width) is controlled by one of two methods depending on the P15 suffix letter. For Modules P15 and P15A, the center frequency is controlled by changing the average value of sweep drive current. This is done by the front-panel **CENTERING** control (Models 301 and 301-1). For Models P15E, F and G, the center frequency is controlled by changing the reverse-bias voltage on the voltage-variable capacitor CR14. This capacitor is part of the sweep oscillator resonant circuit. The RF output of the sweep oscillator is capacity coupled to the buffer amplifier and sweep sample output connectors. Module P15A has trimmer capacitor C17 for initial frequency adjustment.

SPECIFICATIONS

	Plug-in Modules			
	P15A	**P15E**	**P15F**	**P15G**
Center Freq Range	41.5–45.5	35.75–45.75	35.5–51.5	45.75–55.75
Sweep Width (max)	16 MHz	10 MHz	16 MHz	10 MHz
Linearity	±5%	±5%	±5%	±5%
RF Output no. 1	1 V rms	----	1 V rms	----
RF Output no. 2	----	10 mV	10 mV	10 mV
Output Impedance	75 ohms	15 ohms	75 ohms	15 ohms
RF Output Flatness	±0.25 db	----	±0.25 db	----
RF Blanking	yes	yes	yes	yes

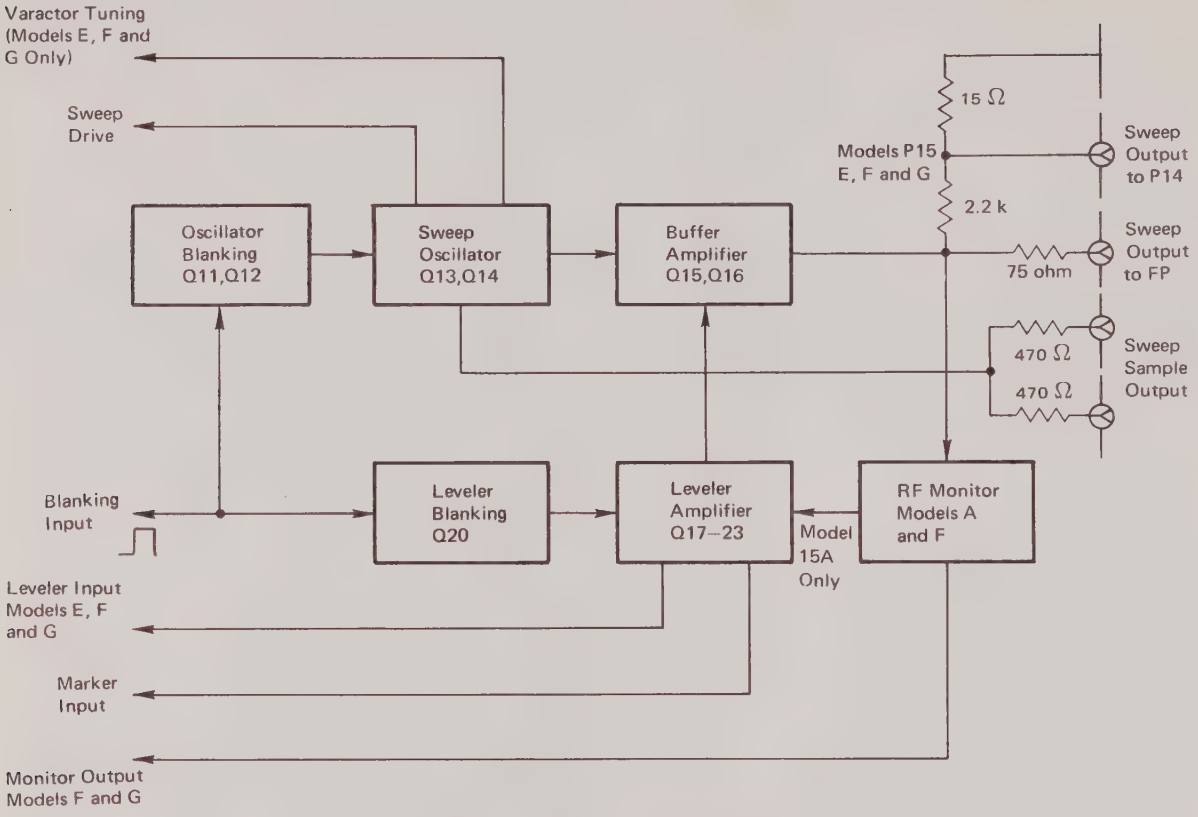


Figure 6-1. Module P15 block diagram.

Buffer Amplifier

The buffer amplifier consists of transistors Q15 and Q16 and associated circuitry. The purpose of the buffer amplifier is to provide a minimum of 1 volt rms RF output and to isolate the sweep oscillator from the output circuits. The RF output is transformer coupled by the T11 to the output filter, T12 and C24. After filtering, the RF output is routed to the output connector.

RF Output Circuit

Some differences in the RF output circuits exist between the modules. For Module P15 and P15A, This output is routed through a 75-ohm source resistor to the output connector. Module P15E has a 2.2-k resistor instead of 75 ohms, and Modules P15F and G have both RF output circuits.

RF Monitor and Leveler Amplifier

The purpose of the RF monitor and leveler amplifier is to maintain a constant-amplitude sweep output voltage and establish the source impedance. The RF monitor consists of detector diode CR11 and decoupling network C25/R27. The electrical function of this circuit is that of a half-wave peak RF detector. The diode is connected to provide a negative dc output for operation of the leveler amplifier.

The leveler amplifier consists of transistors Q17 through Q23. The electrical function of these circuits is that of a high gain dc amplifier. This amplifier receives the output signal from the RF monitor, amplifies and inverts the phase, and supplies a correction voltage to the buffer amplifier and/or Module P14. Level control R37 sets the average dc output from the amplifier, therefore controlling the RF output. This control is normally adjusted to provide 1 volt rms at the front-panel **RF OUTPUT** connector.

MAINTENANCE

Troubleshooting

The troubleshooting chart should be used only after a trouble has been localized to the P15 module. Localizing a

fault can be accomplished by using the power supply diagram, applicable module wiring diagram, and the basic instrument maintenance sections.

MODULE P15 TROUBLESHOOTING CHART

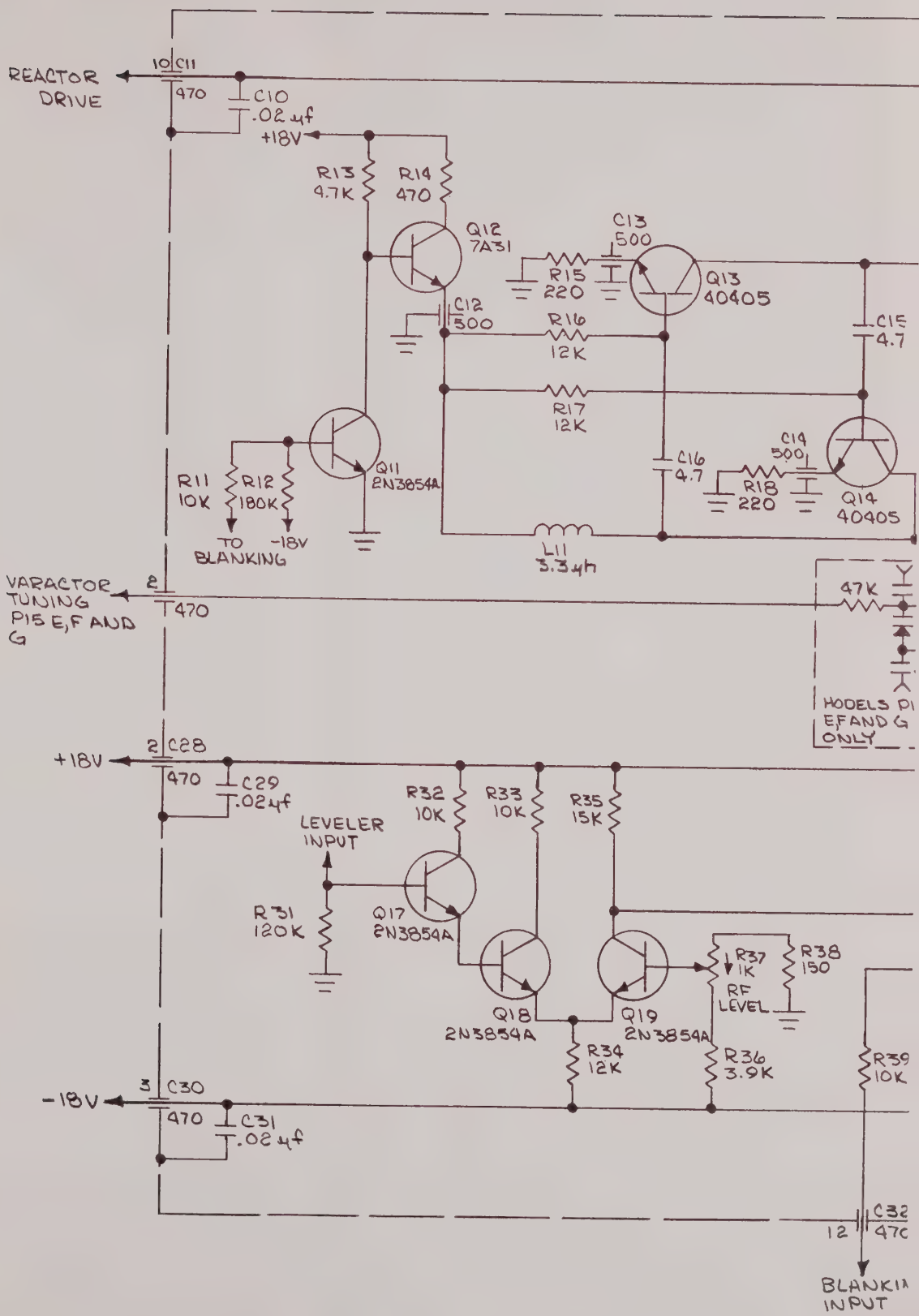
Symptom	Possible Trouble	Solution
No RF	Defective RF detector. Level controls maladjusted.	See Calibration Section.
	Defective transistors Q13 and Q14, Q15 and Q16.	Replace.
Low RF output.	Level control maladjusted (R37).	See Calibration Section.
RF output not level.	Level control maladjusted.	See Calibration Section
No video output.	Defective P14 module.	See P14 maintenance section.

MODULE P15 PARTS LIST

Reference	Description	Part Number
Capacitors		
C10	Ceramic disc, 0.02 μF, ±20%, 50 V	CD-103-320
C11,C30,C32	Ceramic feed, 470 pF, ±20%, 500V	CF-101-147
C12–14	Ceramic feed, 500 pF, ±20%, 250V	CF-104-147
C15,C16,C18 C19,C23, C27	Ceramic disc, 4.7 pF, ±5%, 1 kV	CD-101-R47
C17	Variable ceramic, 3.5/13 pF	CV-101-013
C20,C21	Ceramic disc, 0.001 μF, ±20%, 1 kV	CD-102-210
C22	Ceramic disc, 6.8 pF, ±5%, 1 kV	CD-101-R68
C24	Ceramic disc, 33 pF, ±5%, 1 kV	CD-101-033
C25	Ceramic feed, 500 pF, ±10%, 250V	CF-104-150
C28	Ceramic feed, 470 pF, ±20%, 500V	CF-101-147
C29,C31	Ceramic disc, 0.02 μF, ±20%, 50 V	CD-103-320
C33	Ceramic disc, 270 pF, ±20%, 1 kV	CD-102-127
C34	Ceramic disc, 0.01 μF, ±20%, 1 kV	CD-103-310
C35	Ceramic feed, 6.8 pF, ±10%, 500V	CF-102-R68
Resistors		
R11,R32,R33, R39	Fixed, comp, 10 k, ±10%, ¼ W	RC-104-310
R12	Fixed comp, 180 k, ±10%, ¼ W	RC-104-418
R13,R45	Fixed comp, 4.7 k, ±10%, ¼ W	RC-104-247
R14,R29,R30, R48*	Fixed, comp, 470 Ω, ±10%, ¼ W	RC-104-147

MODULE P15 CON'T

Reference	Description	Part Number
Resistors		
R15,R18–20, R28	Fixed, comp, 220 Ω, ±10%, ¼ W	RC-104-122
R16,R17,R34	Fixed, comp, 12 k, ±10%, ¼ W	RC-104-115
R21,R22	Fixed, comp, 68 k, ±10%, ¼ W	RC-104-312
R23,R24	Fixed, comp, 4.7 Ω, ±10%, ¼ W	RC-104-368
R25	Fixed, comp, 75 Ω, ±5%, ¼ W	RC-104-R47
R27,R46	Fixed, comp, 1 k, ±10%, ¼ W	RC-103-075
R31	Fixed, comp, 120 k, ±10%, ¼ W	RC-104-210
R35,R41	Fixed, comp, 15 k, ±10%, ¼ W	RC-104-412
R36	Fixed, comp, 3.9 k, ±10%, ¼ W	RC-104-315
R37	Variable, carb, 1 k, ±20% PW	RC-104-239
R38	Fixed, comp, 150 Ω, ±10%, ¼ W	RP-105-210
R40	Fixed, comp, 180 k, ±10%, ¼ W	RC-104-418
R42	Fixed, comp, 8.2 k, ±10%, ¼ W	RC-104-282
R43	Fixed, comp, 15 k, ±10%, ½ W	RC-106-315
R44	Fixed, comp, 2.2 k, ±10%, ½ W	RC-106-222
R47	Fixed, comp, 47 k, ±10%, ¼ W	RC-104-347
Transistors		
Q11,Q17–20, Q22	NPN, Si, 2N3854A	QA-038-541
Q12,Q23	NPN, Si, GE 7A31	QB-000-005
Q13–16	NPN, Si, RCA 40405	QB-000-002
Q21	PNP, Ge, 2N1305	QA-013-050
Diodes		
CR11	Si, 75 PIV, 50 mA	DG-100-341
CR12,CR13	Si, 100 PIV, 750 mA	DR-000-001
Inductors		
L11,L13	3.3 μH, ±10%	LA-001-R33
L12	Electronically variable inductor	LE-001-001
L14	16 turns, No. 30 wire, 1/8-in. form	Not assigned
Connectors		
J1	Jack, receptacle, 75 ohm submin	JF-000-004
J2,J3	Jack, receptable, 50 ohm submin	JF-000-005
Transformers		
T11	No. 30 wire on LC 000-005 core	Not assigned
Miscellaneous		
Terminal	Teflon cloverleaf, 0.148 diam	HT 101-000
Terminal	Teflon cloverleaf, 0.185 diam	HT-102-000
Pot mounting nut	Hex sixe ¼ in.	HN-110-000


REACTOR DRIVE
10
C11
470
C10
.02 µf
+18V
R13
4.7K
R14
470
Q12
7A31
C13
500
R15
220
Q13
40405
C12
500
R16
12K
C15
4.7
R17
12K
C16
4.7
C14
500
R18
220
Q14
40405
R11
10K
R12
180K
Q11
2N3854A
TO BLANKING
-18V
L11
3.3µh
VARACTOR TUNING PIS E,F AND G
8
470
47K
MODELS PI E,F AND G ONLY
+18V
2
C28
470
C29
.02µf
R32
10K
R33
10K
R35
15K
LEVELER INPUT
R31
120K
Q17
2N3854A
Q18
2N3854A
Q19
2N3854A
R37
1K
RF LEVEL
R38
150
R34
12K
R36
3.9K
R39
10K
-18V
3
C30
470
C31
.02µf
12
C32
47C
BLANKIN INPUT

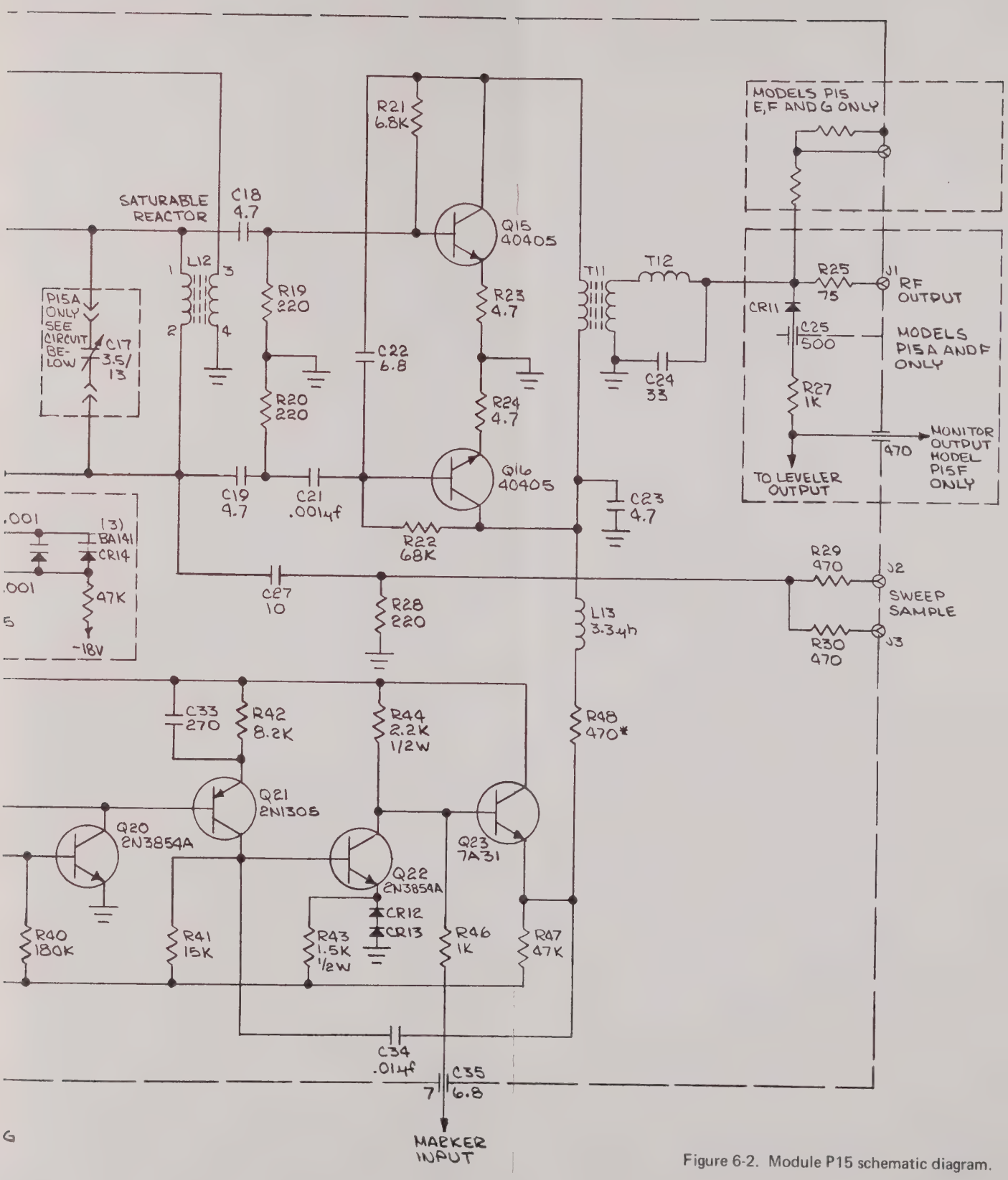


Figure 6-2. Module P15 schematic diagram.

SECTION 7
MODULE P2 WAVE SHAPER

INTRODUCTION

Plug-in Module P2 generates a square-wave signal (blanking) and a triangle-wave signal (scope horizontal and sweep width drive). It also contains the necessary circuitry for driving the saturable reactor and varactor located in the sweep oscillator module. Module P2D is used with Model 301; P2E with 201; P2F with 310; and P2G with 202. The differences in these units and the parts list/schematic diagram are given in this section.

CIRCUIT DESCRIPTION

Square Wave Generator (All modules)

The 27-volt ac signal applied to pin 4 is converted to a 60-Hz square wave by Schmitt trigger circuit Q11/Q12. The square-wave output is then fed to the blanking circuits in other modules and to traingle waveform generator Q13.

Triangle Waveform Generator (All modules)

An integrator converts the square-wave input of Q13 to a triangle waveform at the collector of Q13. Buffer Q14 prevents loading of the integrator and provides a low-impedance output for the scope horizontal signal and sweep adjustment potentiometers.

Modules P2E and P2F provide an inverted triangle for the horizontal drive signal with a second output from the Q14 collector. Module P2E also incorporates a following emitter follower, Q15, for low-impedance loads.

Saturable Reactor Drive Circuit (All models)

Transistors Q51/Q52 (Q15/Q16 for P2D) is a Darlington compound stage that supplies the current to the saturable reactor drive winding, which is in the Q52 (Q16 for P2D) collector circuit. The current in the drive winding can be conveniently determined by voltage measurement at pin 10 (1 volt equals 5 milliamperes). Diodes CR51 and CR52 (not in P2D) compensate for the V_{EB} change of the Darlington with temperature. Centering will change the average dc level of the waveform from less than 1 to over 9 volts (less than 1 to over 5 volts for P2D), referenced to −18 V, and the sweep width will adjust the amount of slope.

The resultant Q52 (Q16 for P2D) collector current determines the average inductance of the sweep oscillator tank circuit (centering) and also the amount of change above and below this average value (sweep width).

Varactor Tuning Circuit (P2E, F, and G)

The sweep oscillator tank capacity is provided by a varactor (voltage-tuned diode) whose capacity is controlled by the front-panel tuning control. The **TUNING HI** and **TUNING LO** adjustments determine the voltage supplied to this tuning control, and therefore, the sweep oscillator tuning range. **TUNING HI** adjusts the voltage at the high-frequency end of the tuning potentiometer from approximately −13 to +18 volts. **TUNING LO** adjusts the voltage at the low-frequency end of the tuning potentiometer from 0 to 91 volts.

TROUBLESHOOTING

Since each stage is dependent on the preceding stage for operation, trouble can be isolated by checking the waveforms in sequence. After isolation to a single stage, the trouble can be located by visual inspection, voltage and current measurements, ohm meter checks and part substitution. The module cover can be taken off by removing the nuts on the adjustment potentiometers. Special attention should also be given to the module plug-in pins and associated chassis sockets for proper alignment.

Caution: Because of the high voltage (+180 volts) used in these modules, accidental shorts caused by test probes can cause permanent damage to the transistors.

MODULE P2E PARTS LIST

Reference	Description	Part Number
Capacitors		
C11,C16, C53–58	Ceramic feed, 470 pF, 20%, 500V	CF-101-147
C12	Ceramic dielec, 0.02 μF, 20%,200V	CD-106-320
C13	Mica dielec, 0.005 μF, 5%, 500V	CM-101-250

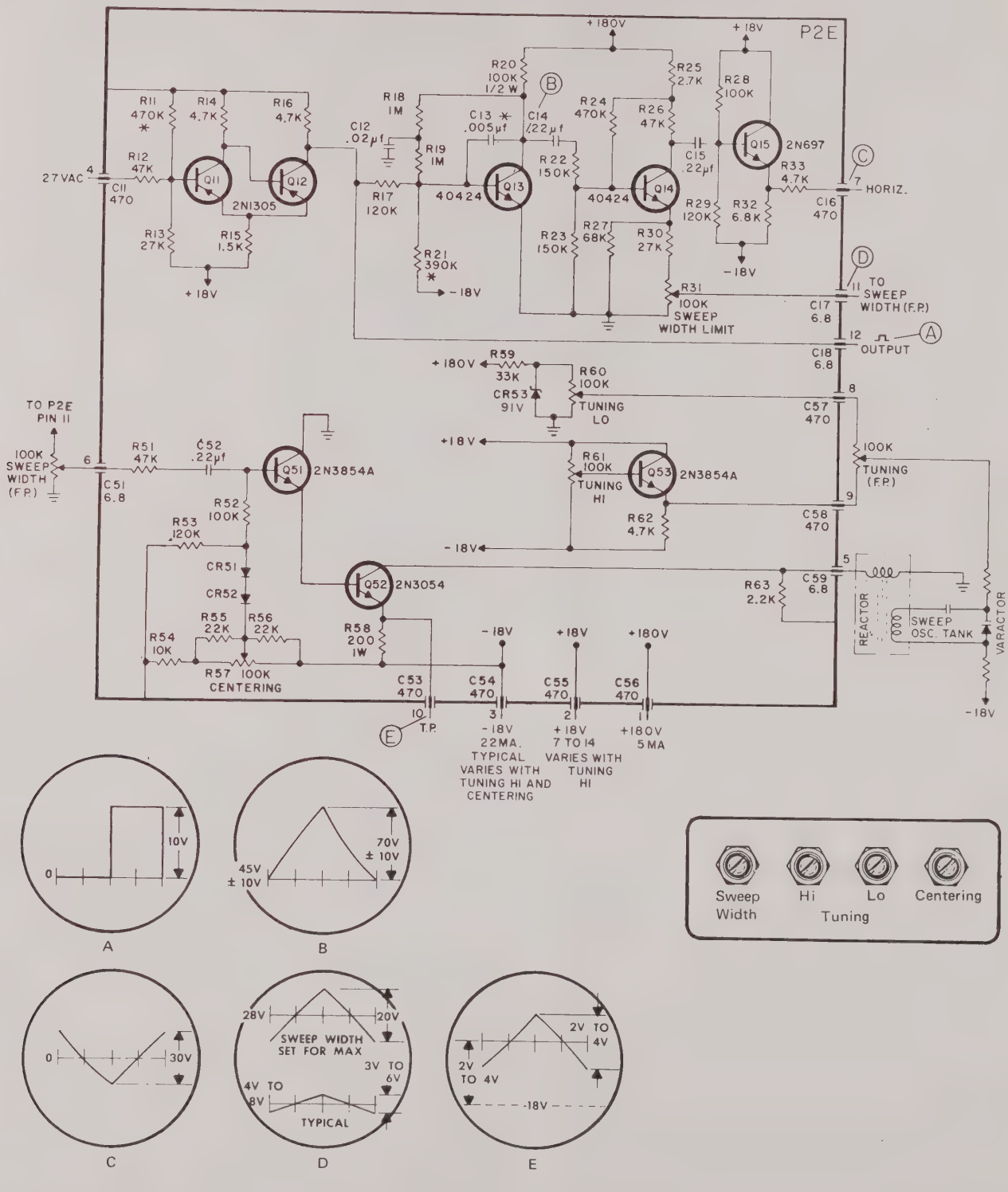


Figure 7-1. Module P2E schematic diagram.

MODULE P2E CON'T

Reference	Description	Part Number
Capacitors		
C14,C52	Mylar dielec, 0.22 μF, 10%, 200V	CP-101-422
C15	Mylar dielec, 0.22 pF, 10%, 200V	CP-101-422
C17,C18, C51,C59	Ceramic feed, 6.8 pF, 10%, 500V	CF-102-R68
Diodes		
CR51,CR52	Si, 100 PIV, 750 mA	DR-000-001
CR53	Zener, 91 V, 1 W	DB-000-005
Resistors		
R11,* R24	Fixed, comp, 470 k, 10%, ¼ W	RC-104-447
R12,R26,R51	Fixed comp, 47 k, 10%, ¼ W	RC-104-347
R13,R30,	Fixed comp, 27 k, 10%, ¼ W	RC-104-327
R14,R16,R33	Fixed comp, 4.7 k, 10%, ¼ W	RC-104-247
R15	Fixed comp, 1.5 k, 10%, ¼ W	RC-104-215
R17,R29	Fixed comp, 120 k, 10%, ¼ W	RC-104-412
R18,R19	Fixed comp, 1 MΩ 10%, ¼ W	RC-104-510
R20	Fixed comp, 100 k, 10%, ½ W	RC-106-410
R21*	Fixed comp, 390 k, 10%, ¼ W	RC-104-439
R22,R23	Fixed comp, 150 k, 10%, ¼ W	RC-104-415
R25	Fixed comp, 2.7 k, 10%, ¼ W	RC-104-227
R27	Fixed comp, 68 k, 10%, ¼ W	RC-104-368
R28,R52	Fixed comp, 100 k, 10%, ¼ W	RC-104-410
R31	Variable carb, 100 k, 30%, ¼ W	RP-105-410
R32	Fixed comp, 6.8 k,,10% ¼ W	RC-104-268
R53	Fixed comp, 120 k, 10%, ¼ W	RC-104-420
R54	Fixed comp, 10 k, 10% ¼ W	RC-104-310
R55,R56	Fixed comp, 22 k, 10% ¼ W	RC-104-322
R57,R60,R61	Variable carb, 100 k, ±30%, ¼ W	RP-105-410
R58	Fixed comp, 200 Ω, ±5%, 1 W	RC-107-120
R59	Fixed comp, 33 k, ±10%, ¼ W	RC-104-333
R62	Fixed comp, 4.7 k, ±10%, ¼ W	RC-104-247
R63	Fixed comp, 2.2 k, ±10%, ¼ W	RC-104-222
Transistors		
Q11,Q12	PNP, Ge, 2N1305	QA-013-050
Q13,Q14	NPN, Si, high voltage, RCA40424	QB-000-004
Q15	NPN, Si, 2N697	QA-006-970
Q51,Q53	NPN, Si, 1N3854A	QA-038-541
Q52	NPN, Si, 2N3054	QA-030-540
Miscellaneous		
Insulator	Transistor mounting, mica, TO66	HX-101-000
Shoulder	Nylon, size no. 6	HW-110-600
Terminal	Teflon cloverleaf, 0.148 diam	HT-101-000
Terminal	Teflon cloverleaf, 0.185 diam	HT-102-000
Pot mounting nut	Hex, size ¼ in.	HN-110-000

*Indicates factory adjusted value.

MODULE P2F REPLACEMENT PARTS LIST

Reference	Description	Part Number
Capacitors		
C11,C16,C17, C53–58	Ceramic feed, 470 pF, 20%, 500V	CF-101-147

MODULE P2F CON'T

Reference	Description	Part Number
Capacitors		
C12	Ceramic dielec,0.02 μF, 20%, 200V	CD-106 320
C13	Mica dielec, 0.005 μF, 5%, 500V	CM-101-250
C14,C52	Mylar dielec, 0.22 μF, 10%, 200V	CP-101-422
C15	Ceramic disc, 0.01 μF, 10%, 200V	CD-106-310
C18,C51,C59	Ceramic feed, 6.8 pF, 10%, 500V	CF 102-R68
Diodes		
CR51,CR52	Si, 100 PIV	DR 000-001
CR53	Zener, 91 V, 1 W	DB 000-005
Resistors		
R11,R24	Fixed comp, 470 k, 10%, ¼ W	RC-104-447
R12,R51	Fixed comp, 47 k, 10%, ¼ W	RC-104-347
R13	Fixed comp, 27 k, 10%, ¼ W	RC-104-327
R14,R16	Fixed comp, 4.7 k, 10%, ¼ W	RC-104-247
R15	Fixed comp. 1.5 k, 10%, ¼ W	RC-104-215
R17,R53	Fixed comp, 120 k, 10%, ¼ W	RC-104-412
R18,R19	Fixed comp, 1 MΩ 10%, ¼ W	RC-104-510
R20	Fixed comp, 100 k, 10%, ½ W	RC 106-410
R21	Fixed comp, 390 k, 10%, ¼ W	RC-104-439
R22,R23	Fixed comp, 150 k, 10%, ¼ W	RC-104-415
R25	Fixed comp, 2.7 k, 10%, ¼ W	RC-104-227
R26	Fixed comp, 12 k, 10%, ¼ W	RC-104 312
R52	Fixed comp, 100 k, 10%, ¼ W	RC-104-410
R54	Fixed comp, 10 k, 10%, ¼ W	RC-104-310
R55,R56	Fixed comp, 22 k, ±10%, ¼ W	RC-104-322
R57,R60,R61	Variable carb, 100 k, ±10%, ¼ W	RP-105-410
R58	Fixed comp, 200 Ω,±5%, 1 W	RC-107-120
R59	Fixed comp, 33 k, ±10%, ¼ W	RC-104-333
R62	Fixed comp, 4.7 k, ±10%, ¼ W	RC-104-247
R63	Fixed comp, 2.2 k, ±10%, ¼ W	RC 104-220
Transistors		
Q11,Q12	PNP, Ge, 2N1305	QA-013-050
Q13,Q14	NPN, Si, high voltage, RCA40424	QB-000 004
Q51,Q53	NPN, Si, 2N3854A	QA-038-541
Q52	NPN, Si, 2N3054	QA 030-540
Miscellaneous		
Insulator	Transistor mounting, mica, TO66	HX 101-000
Shoulder wshr	Nylon, size no. 6	HW-110-600
Terminal	Teflon cloverleaf, 0.148 diam	HT-101 000
Terminal	Teflon cloverleaf, 0.185 diam	HT-102 000
Pot mounting nut	Hex, size ¼ in.	HN-110-000

MODULE P2G REPLACEMENT PARTS LIST

Reference	Description	Part Number
Capacitors		
C11,C15, C53–58	Ceramic feed, 470 pF, 20%, 500V	CF-101 147
C12	Ceramic dielec, 0.002 μF, 20%, 200V	CD-106-320
C13	Mica dielec, 0.005 μF, 5%, 500V	CM 101-250
C14,C52	Mylar dielec, 0.22 μF, 10%, 200V	CP-101-422
C16,C51,C59	Ceramic feed, 6.8 pF, 10%, 500V	CF-102-R68

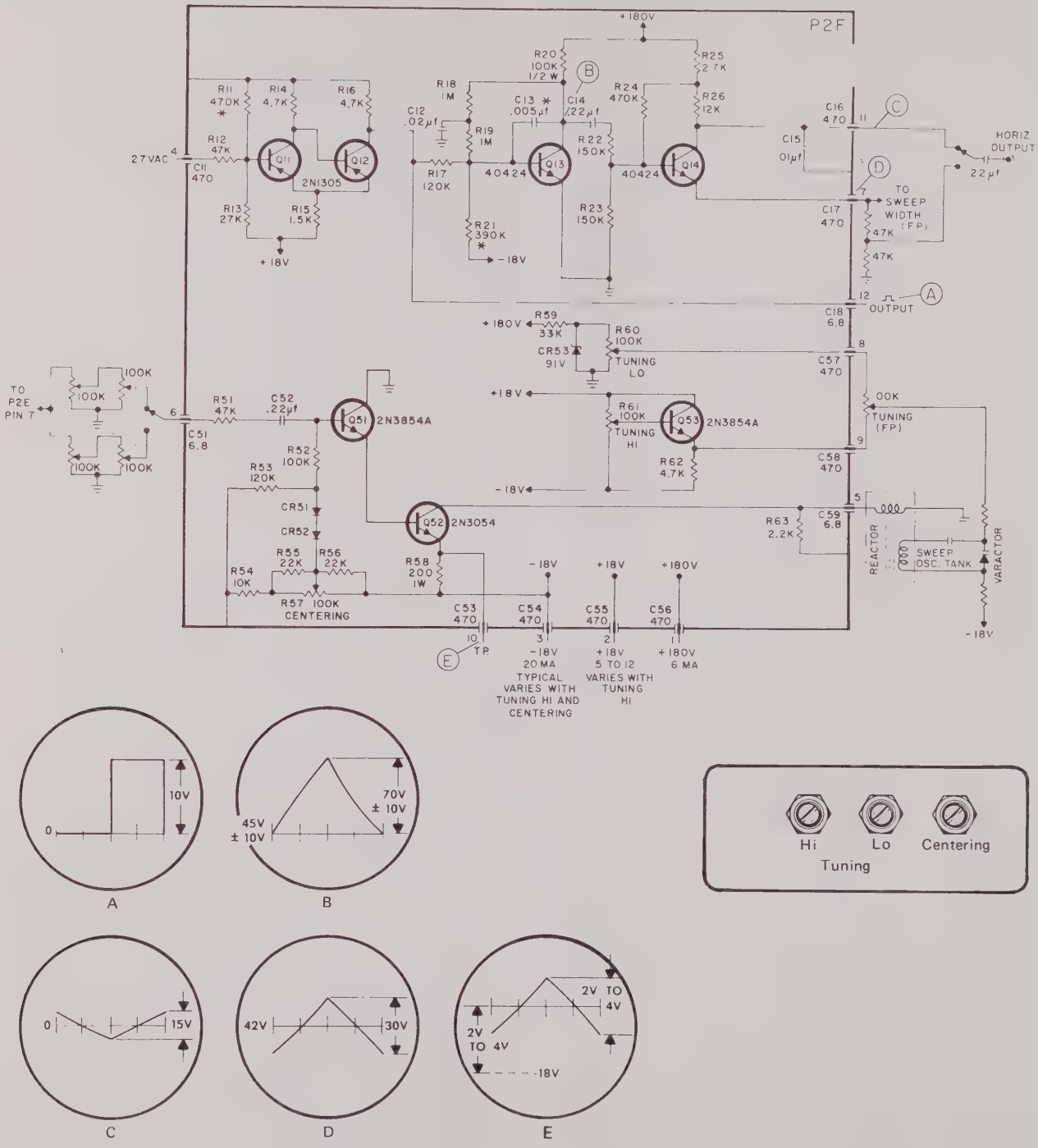


Figure 7-3. Module P2F schematic diagram.

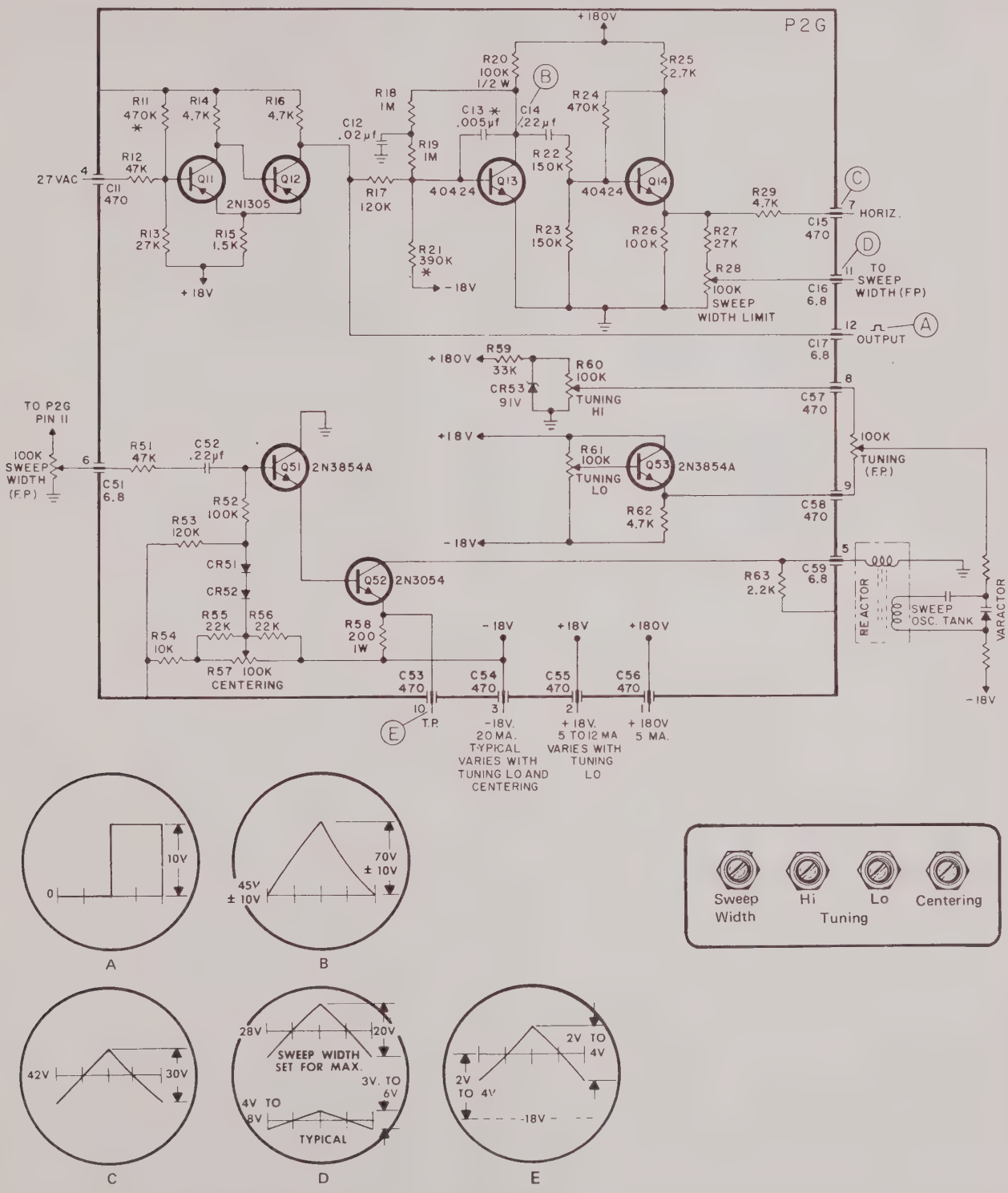


Figure 7-2. Module P2G schematic diagram.

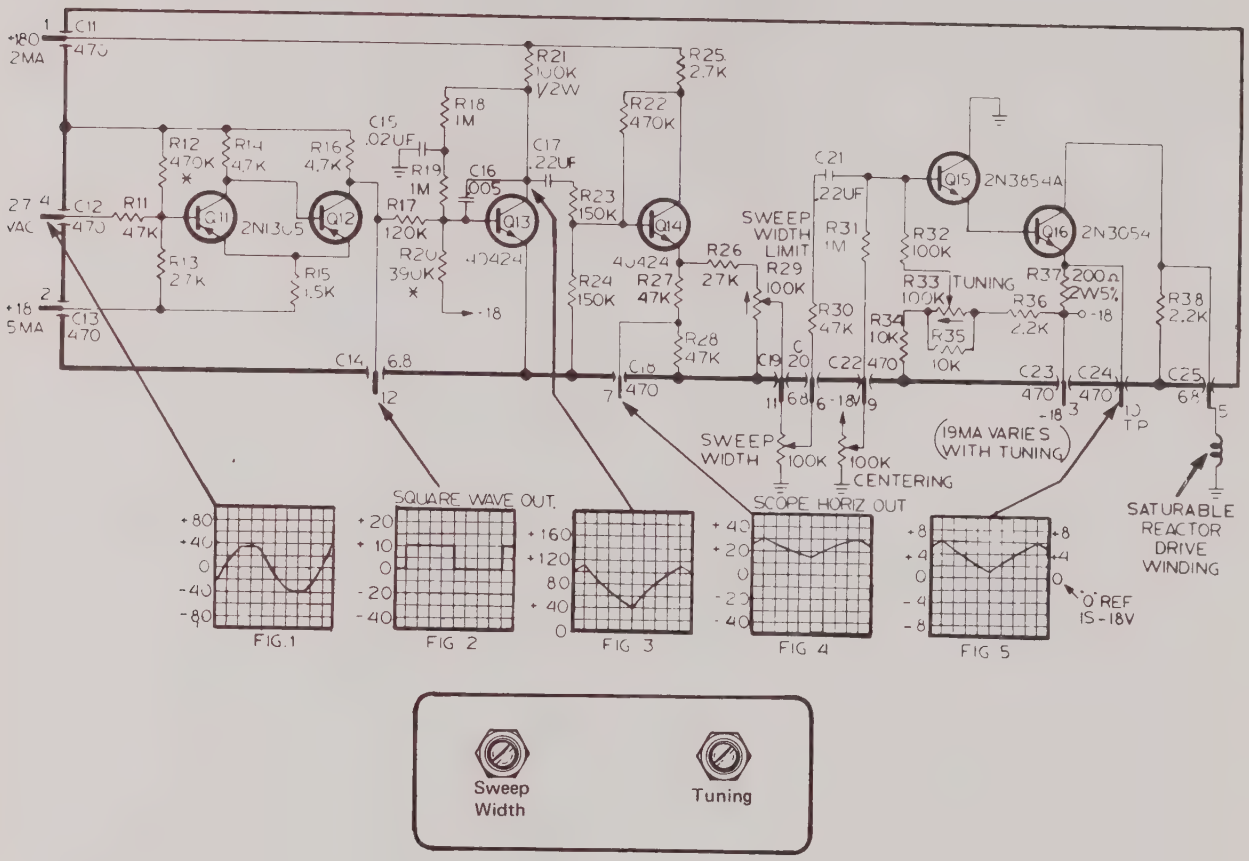


Figure 7-4. Module P2D schematic diagram.

MODULE P2G CON'T

Reference	Description	Part Number
Resistors		
R11,*R24	Fixed comp, 470 k, 10%, ¼ W	RC-104-447
R13,R27	Fixed comp, 27 k, 10%, ¼ W	RC-104-327
R14,R16,R29	Fixed comp, 4.7 k, 10%, ¼ W	RC-104-215
R15	Fixed comp, 1.5 k, 10%, ¼ W	RC-104-215
R17,R53	Fixed comp, 120 k, 10%, ¼ W	RC-104-412
R18,R19	Fixed comp, 1 MΩ 10%, ¼ W	RC-104-510
R20,R26	Fixed comp, 100 k, 10%, ½ W	RC-106-410
R21*	Fixed comp, 390 k, 10%, ¼ W	RC-104-439
R22,R23	Fixed comp, 150 k, 10%, ¼ W	RC-104-415
R25*	Fixed comp, 2.7 k, 10%, ¼ W	RC-104-227
R28	Variable carb, 100 k, ±30%, ¼ W	RP-105-410
R52	Fixed comp, 100 k, 10%, ¼ W	RC-104-410
R54	Fixed comp, 10 k, 10%, ¼ W	RC-104-310
R55,R56	Fixed comp, 22 k, 10%, ¼ W	RC-104-322
R57,R60,R61	Variable carb, 100 k, ±30%, ¼ W	RP-105-410
R58	Fixed comp, 200 Ω, ±5%, 1 W	RC-107-120
R59*	Fixed comp, 33 k, ±10%, ¼ W	RC-104-333
R62	Fixed comp, 4.7 k, ±10%, ¼ W	RC-104-247
R63	Fixed comp, 2.2 k, ±10%, ¼ W	RC-104-222
Diodes		
CR51,CR52	Si, 100 PIV, 750 mA	DR-000-001
CR53	Zener, 91 V, 1 W	DB-000-005
Transistors		
Q11,Q12	PNP, Ge, 2N1305	QA-013-050
Q13,Q14	NPN, Si high voltage, RCA40424	QB-000-004
Q51,Q53	NPN, Si, 2N3854A	QA-038-541
Q52	NPN, Si, 2N3054	QA-030-540
Miscellaneous		
Insulator	Transistor mounting, mica, TO66	HX-101-000
Shoulder wshr	Nylon, size no. 6	HW-110-600
Terminal	Teflon cloverleaf, 0.148 diam	HT-101-000
Terminal	Teflon cloverleaf, 0.185 diam	HT-102-000
Pot mounting nut	Hex, size ¼ in.	HN-110-000

*Indicates factory adjusted value.

MODULE P2D REPLACEMENT PARTS LIST

Reference	Description	Part Number
Capacitors		
C11–13,C18, C22–24	Ceramic feed, 470 pF, ±20%, 500V	CF-101-147
C14,C19,C20 C25	Ceramic feed, 6.8 pF, ±10%, 500V	CF-102-R68
C15	Ceramic dielec, 0.02 μF, ±20%, 200V	CD-106-320
C16	Mica dielec, 0.005 μF, ±5%, 500V	CM-101-250
C17,C21	Mylar dielec, 0.22 μF, ±10%, 200V	CP-101-422
Resistors		
R11,R27, R28,R30	Fixed, comp, 47 k, ±10%, ¼ W	RC-104-347
R12,R22	Fixed, comp, 470 k, ±10%, ¼ W	RC 104-447
R13	Fixed, comp, 27 k, ±10%, ¼ W	RC-104-327
R14,R16	Fixed, comp, 4.7 k, ±10%, ¼ W	RC-104-247
R15	Fixed, comp, 1.5 k, ±10%, ¼ W	RC-104-215
R17	Fixed, comp, 120 k, ±10%, ¼ W	RC-104-412
R18,R19	Fixed, comp, 1 MΩ, ±10%, ¼ W	RC-104-510
R20	Fixed, comp, 390 k, ±10%, ¼ W	RC-104-439
R21	Fixed, comp, 100 k, ±10%, ½ W	RC-104-410
R23,R24	Fixed, comp, 150 k, ±10%, ¼ W	RC-104-415
R25	Fixed, comp, 2.7 k, ±10%, ¼ W	RC-104-227
R26	Fixed, comp, 270 k, ±10%, ¼ W	RC-104-427
R29,R33	Variable carb, 100 k, ±30%, ¼ W	RP-105-410
R31	Fixed, comp, 1 MΩ, ±10%, ¼ W	RC-104 510
R32	Fixed, comp, 100 k, ±10%, ¼ W	RC-104-410
R34, R35	Fixed comp, 10 k, ±10%, ¼ W	RC-104 310
R36,R38	Fixed comp, 2.2 k, ±10%, ¼ W	RC-104-222
R37	Fixed Comp, 200 Ω, ±5%, 2 W	RC-109-120
Transistors		
Q11,Q12	PNP, Ge, 2N1305	QA-013-050
Q13,Q14	NPN, Si,high voltage, RCA40424	QB-000-004
Q15	NPN, Si, 2N3854A	QA-038-541
Q16	NPN, Si, 2N3054	QA-030-540
Miscellaneous		
Insulator	Transistor mounting mica, TO66	HX-101-000
Shoulder wshr	Nylon, size no. 6	HW-110-600
Terminal	Teflon cloverlead, 0.148 diam	HT-101-000
Terminal	Teflon cloverlead, 0.185 diam	HT-102-000
Pot mounting nut	Hex, size ¼ in.	HN-110-000

SECTION 8
MODULE P14 VIDEO AMPLIFIER

INTRODUCTION

Plug-in Module P14 produces a video signal of 1 volt rms from 1 to 10 MHz. The module requires a sweep signal input of 35.75 to 45.75 MHz, or 28.9 to 38.9 MHz, depending on the frequency standard employed. This sweep input signal is converted to a 1 to 10 MHz video signal by heterodyning with a crystal source of 45.75 or 38.9 MHz.

SPECIFICATIONS

Video Output Frequency	1 to 10 MHz.
Video Output Voltage	1 volt rms into 75 ohms.
Video Output Flatness	±0.5 db (1 to 10 MHz).
Video Output Impedance	75 ohms.
RF Input Frequency	USA—35.75 to 45.75 MHz.
	European (—1)28.9 to 38.9 MHz.
Crystal Oscillator Frequency	USA 45.75 Mhz.
	European 38.9 MHz.
RF Input Level	10 mV nominal.

CIRCUIT DESCRIPTION

The electrical relationship between the various circuits in the P14 is shown in Figure 8-1. The sweep input signal from the P15 Module is amplified by IF amplifier and applied to the balanced mixer along with the crystal oscillator signal. This mixed signal output is routed through the low-pass filter which removes all but the difference frequency. This signal is amplified to the required output level by the wideband amplifier. The monitor circuit provides the correction signal to the leveler amplifier in the P15 module.

IF Amplifier

The IF amplifier consists of transistor Q1 and the associated components. This circuit is connected as a broadband common-emitter amplifier with the RF output transformer coupled by T11 to the mixer input.

Crystal Oscillator and Buffer

The crystal oscillator and RF buffer consists of transistor circuits Q2 and Q3, respectively. Crystal oscillator Q2 is a Colpitts type with the crystal operating in the series-resonant mode. The primary of transformer T13 is connected in the oscillator resonant circuit and provides a means of tuning the oscillator. The RF output of the oscillator is coupled to the buffer stage by the secondary of T13. RF buffer stage Q3 provides amplification and isolation for the

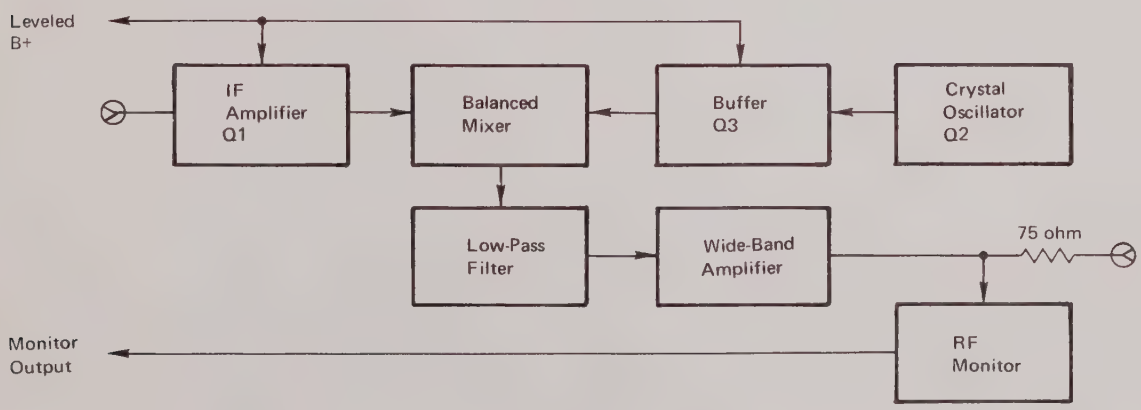


Figure 8-1. Module P14 block diagram.

crystal oscillaotr. This stage is common-emitter amplifier with the RF output transformer coupled into the balanced mixer.

Balanced Mixer

The balanced mixer circuit consists of the secondary of transformers T13 and T11 and mixer diodes CR11–CR14. This circuit is a double-balanced ring modulator that provides efficient mixing with minimum spurious products. Balancing the mixer is accomplished by positioning the secondary of transformer T13 and diode selection. The heterodyned output from the mixer is coupled to the low-pass filter.

Low-Pass Filter

The low-pass filter provides rejection of the fundamental signals used to produce the video output. The filter inductance is adjustable to place the cut off at approximately 12 MHz.

Viedo Amplifier

The video amplifier consists of transistor circuits Q4 to Q9. This amplifier is dc coupled throughout with balance control R26 provided to set the dc output to zero. (Refer to the Calibration Section.)RF gain and bandwidth provides a 1-volt output signal from 1 to 10 MHz with an input signal of only 20 millivolts.

RF Monitor

The RF monitor provides a detected dc voltage, representing the RF output, at the point where the monitor is connected. This voltage is routed to the P15 module and amplified by the leveler circuit. The output of the leveler circuit is used to control the collector voltages of the sweep oscillator and the P14 IF amplifier and crystal oscillator buffer. This action results in a flat video output signal.

MAINTENANCE

Troubleshooting

The troubleshooting chart should be used only after a trouble has been localized to the P14 module. Localizing a fault can be accomplished by using the power supply diagram, module wiring diagram, and the basic instrument maintenance section.

MODULE P14 TROUBLESHOOTING CHART

Symptom	Possible	Solution
No video output.	Maladjustment of P15 level control.	See Calibration Section.
	No RF output from P15 sweep module.	See P15 maintenance instructions.
	Crystal oscillator defective.	Replace Q2.
Low video.	Maladjustment of P15 level control.	See Calibration Section.
	Defective transistors Q1 to Q9.	Replace.
	Defective mixer diodes CR11 to CR14.	Replace.
Video output not flat.	Maladjustment of P15 level control.	See Calibration Section.
	Defective monitor diode.	Replace.

MODULE P14 PARTS LIST

Reference	Description	Part Number
Capacitors		
C10	Ceramic disc, 0.001 μF, ±20%, 1 kV	CD-102-210
C11,C13,C15, C18,C19	Ceramic feed, 500 pF, ±20%, 500V	CF-104-150
C12,C15,C26, C29,C30, C35	Ceramic feed, 470 pF, ±20%, 500V	CF-101-147
C14,C20	Ceramic disc, 47 pF, ±5%, 1 kV	CD-104-047
C16	Ceramic disc, 20 pF, ±5%, 1 kV	CD-101-020
C17	Ceramic disc, 120 pF, ±20%, 1 kV	CD-102-112
C21–23	Ceramic disc, 350 pF, ±20%, 1 kV	CD-102-135
C24	Ceramic disc, 150 pF, ±20%, 1 kV	CD-102-115
C27,C28	Electrolytic 10 μF, 25 V	CE-108-010
C31,C34	Ceramic disc, 0.05 μF, ±20%, 50 V	CD-103-350
C32,C33	Ceramic disc, 0.02 μF, ±20%, 50 V	CD-103-320
Resistors		
R10	Fixed comp, 47 Ω, ±10%, ¼ W	RC-104-047
R11	Fixed comp, 47 Ω, ±5%, ¼ W	RC-105-047
R12	Fixed comp, 68 k, ±10%, ¼ W	RC-104-368
R13	Fixed comp, 4.7 Ω, ±10%, ¼ W	RC-104-R47
R14,R22,R23	Fixed comp, 470 Ω, ±10%, ¼ W	RC-104-147
R15	Fixed comp, 2.2 k, ±10%, ¼ W	RC-104-222
R16	Fixed comp, 27 k, ±10%, ¼ W	RC-104-327
R17	Fixed comp, 5.6 Ω, ±10%, ¼ W	RC-104-056
R18,R19	Fixed comp, 1 k, ±5%, ¼ W	RC-103-210
R20	Fixed comp, 100 Ω, ±10%, ¼ W	RC-104-110
R21,R24	Fixed comp, 68 Ω, ±10%, ¼ W	RC-104-068
R25	Fixed comp, 47 k, ±10%, ¼ W	RC-104-347
R26	Variable carb, 100 k, ±30%, ¼ W	RP-105-410
R27	Fixed comp, 1 k, ±10%, ½ W	RP-106-210
R28	Fixed comp, 5.6 k, ±5%, ¼ W	RC-103-256
R29	Fixed comp, 4.7 k, ±10%, ¼ W	RC-104-247
R30	Fixed comp, 680 Ω, ±10%, ¼ W	RC-104-168
R31	Fixed comp, 3.3 k, ±10%, ¼ W	RC-104-233
R32,R35	Fixed comp, 220 Ω, ±10%, ¼ W	RC-104-122

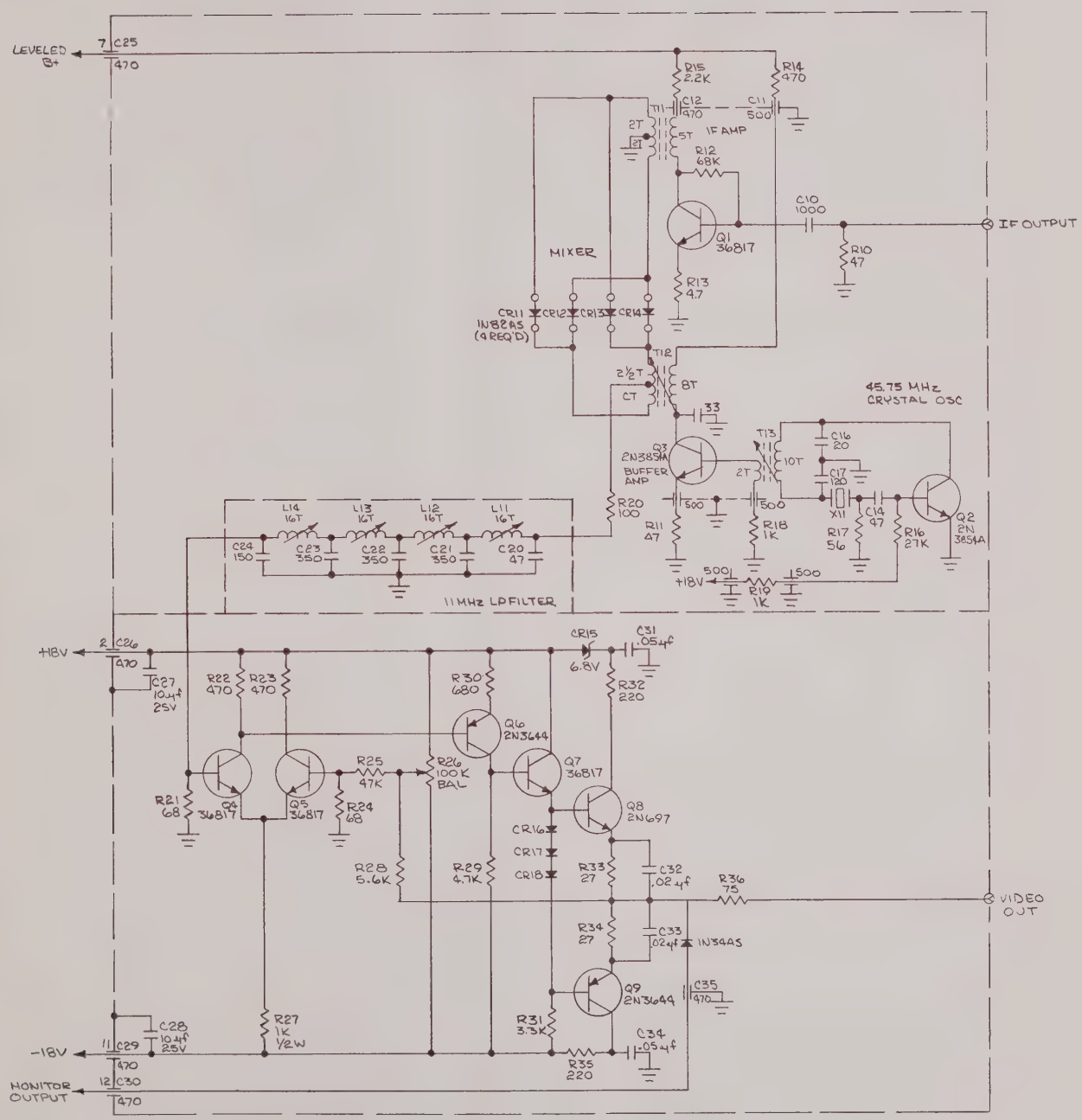


Figure 8-2. Module P14 schematic diagram.

MODULE P14 CON'T

Reference	Description	Part Number
Resistors		
R33,R34	Fixed comp, 27 Ω, ±10%, ¼ W	RC-104-027
R36	Fixed comp, 75 Ω, ±5%, ¼ W	RC-103-075
Inductors		
L10	Fixed, molded, 2.2 mH, ±10%	LA-001-R22
L11–L14	16 turns of no. 30 wire on coil	LB-002-000
Transformers		
T11	5 turns/4 ct of no. 30 wire	LC-000-005
T112	2½ turns ct/8 of no. 30 wire	LB-003-000
T13	2 turns/10 turns of no. 30 wire	LB-003-000
Diodes		
CR11–14	Si, point contact, 1N82AS	DG-100-821
CR15	Zener, 6.8 V, ±10%, 1 W	DB-000-004

MODULE P14 CON'T

Reference	Description	Part Number
Diodes		
CR16–18	Si, junction 100 PIV, 750 mA	DR-000-001
CR19	Ge, point contact 11V34AS	DG-100-341
Crystals		
X11	45.75000 MHz	XX-000-331
Transistors		
Q1,Q4,Q5,Q7	NPN, Si, RCA 36817	QB-000-001
Q2,Q3	NPN, Si, 2N3854A	QA-038-541
Q6,Q9	PNP, Si, 2N3644	QA-036-440
Q8	NPN, Si, 2N697	QA-006-970
Miscellaneous		
Connector	Jack receptacle, 75 ohm	JF-000-004
Terminal	Teflon cloverleaf, 0.148 diam	HT-101-000

SECTION 9
MODULE P13 MARKER GENERATOR

INTRODUCTION

The P13 marker module produces up to five crystal-controlled pulse-type markers in the IF frequency range at customer-specified frequencies.

SPECIFICATIONS

Frequency Range	29 to 55 MHz.
Marker Accuracy	0.01%* of crystal frequency.
Marker Amplitude	At least 30 V.
Marker Polarity	Positive and negative.
Marker Width	Approximately 75 μsec.
Number of Markers	5 per module.

*Accuracy is referenced to the low frequency side of the pulse.

CIRCUIT DESCRIPTION

The P13 marker module contains five independent crystal-filter circuits. These circuits generate the basic marker pulses. The output of the crystal filters is detected and amplified to provide 30-volt pulses. See the block diagram in Figure 9-1 .

Crystal Filters

Each module contains five crystal filter circuits. These circuits are independent and operate anywhere in the IF frequency range (29 to 55 MHz). The crystal filters act as very high-Q resonant circuite, generating sharp bursts of RF energy at their resonant frequency. These bursts of RF are detected by CR11 and connected to the base of the first pulse amplifier.

Sweep Sample Amplifier

Sweep sample amplifier Q11 is connected as a common-emitter broadband amplifier. The collector load is a broadband transformer, T11, which is tapped to match the input impedance of the crystal filter circuits. Level adjustment R12 is provided to adjust the amount of sweep sample to the crystals. This control should be set to produce saturated marker pulses.

Pulse Amplifiers

The pulse amplifier circuits consist of transistors Q12 through Q18. These circuits convert the small output from the crystal filters to dc voltage pulses. Transistors Q15 through Q18 are common to all crystal filters. Positive pulse output is provided by invertor circuit Q18.

MAINTENANCE

Troubleshooting

The troubleshooting chart should be used only after a trouble has been localized to the P13 module. Localizing a fault can be accomplished by using the power supply diagram, module wiring diagram and the basic instrument maintenance section.

MODULE P13 TROUBLESHOOTING CHART

Symptom	Possible Trouble	Solution
All markers missing.	Incorrect adjustments of sweep sample level control R12.	See Calibration Section
	Transistor Q11 defective.	Replace
	Transistor Q15, Q16, Q17 or Q18 defective.	Replace
One marker missing.	Incorrect adjustment of sweep sample level control R12.	See Calibration Section.
	Transistor Q12, Q13, or Q14 defective.	Replace.
Spurious markers present.	Incorrect adjustment of sweep sample level control R12.	See Calibration Section.

MODULE P13 PARTS LIST

Reference	Description	Part Number
Capacitors		
C11,C25–32	Ceramic feedthru, 470 pF, 20%, 500 V	CF-101-147
C12,C13,C19*	Ceramic disc, 0.001 μF, 20%, 1 kV	CD-102-210
C14	Ceramic disc, 0.02 μF, 20%, 200 V	CD-106-320

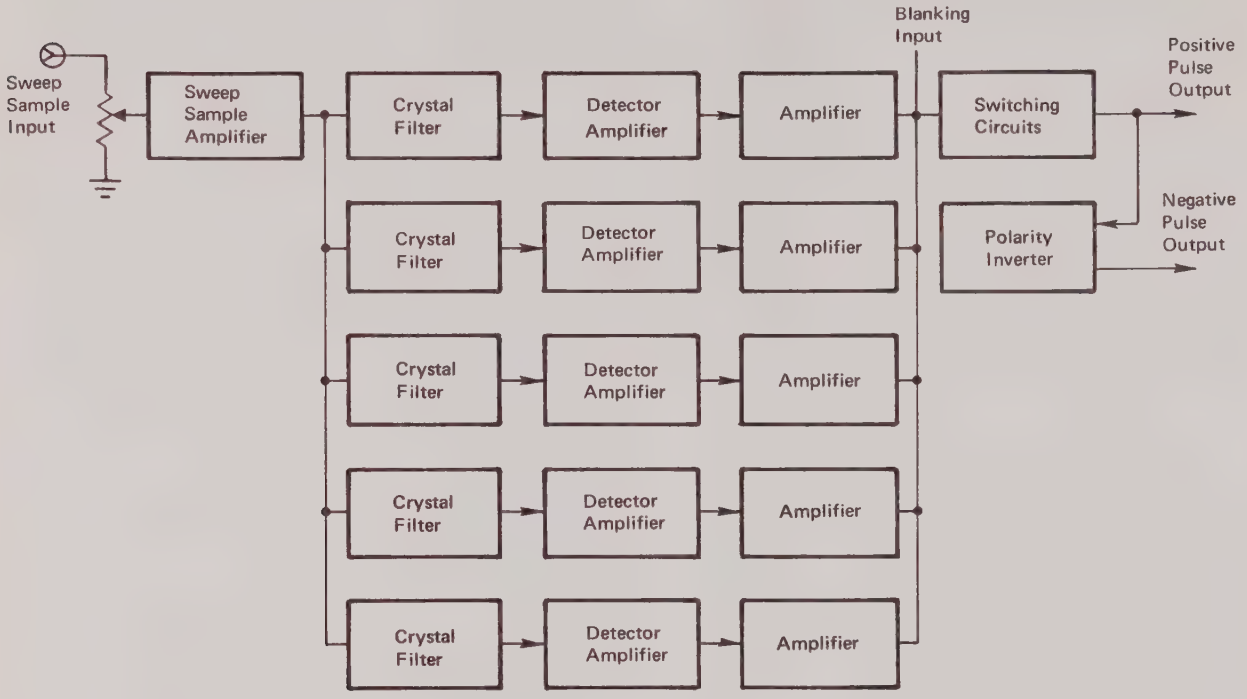


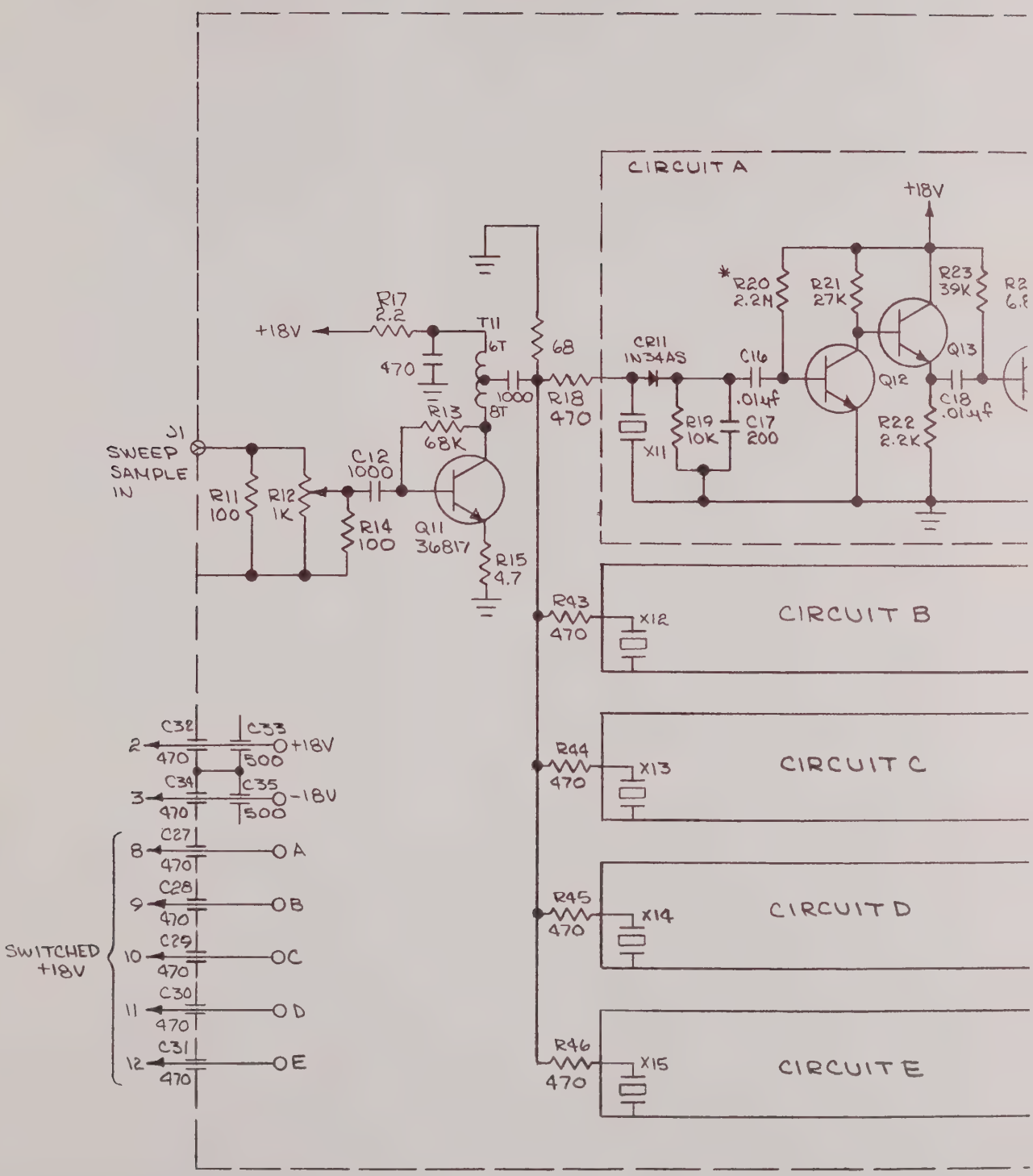
Figure 9-1. Module P13 block diagram.

MODULE P13 CON'T

Reference	Description	Part Number
C15,C33,C35	Ceramic feedthru, 500 pF, 20%, 250 V	CF-104-150
C16,*C18,*C22	Ceramic disc, 0.01 μF, 20%, 50 V	CD-103-310
C17,*C20*	Ceramic disc, 200 pF, 20%, 1 kV	CD-102-120
C21	Ceramic disc, 0.003 μF, 20%, 1 kV	CD-102-230
C23,C24	Ceramic disc, 0.1 μF, 20%, 50 V	CD-103-410
C34	Ceramic feedthru, 470 pF, 20%, 500 V	CF-101-147
C36–39	Ceramic disc, 200 pF, 20%, 1 kV	CD-102-120
Crystals		
X11–14	At customer specified frequencies	XX-000-350
Diodes		
CR11*,CR12*, CR13,CR14	Ge, point contact 1N34AS	DG-100-341
Resistors		
R11,R14	Fixed comp, 100 Ω, 10%, ¼ W	RC-104-110
R12	Variable carb, 1 k, 30%, ¼ W	RP-105-210
R13	Fixed comp, 68 k, 10%, ¼ W	RC-104-368
R15	Fixed comp, 4.7 Ω 10%, ¼ W	RC-104-R47
R16	Fixed comp, 68 Ω, 10%, ¼ W	RC-104-068

MODULE P13 CON'T

Reference	Description	Part Number
R17	Fixed comp, 2.2 Ω, 10%, ¼ W	RC-104-R22
R18	Fixed comp, 470 Ω, 10% ¼ W	RC-104-147
R19*	Fixed comp, 10 k, 10%, ¼ W	RC-104-310
R20**	Fixed comp, 1.8 M, 10%, ¼ W	RC-104-518
R21*	Fixed comp, 27 k, 10%, ¼ W	RC-104-327
R22*,R27	Fixed comp, 2.2 k, 10%, ¼ W	RC-104-222
R23*	Fixed comp, 39 k, 10%, ¼ W	RC-104-339
R24*	Fixed comp, 6.8 k, 10%, ¼ W	RC-104-268
R25*	Fixed comp, 470 k, 10%, ¼ W	RC-104-447
R26	Fixed comp, 82 k, 10%, ¼ W	RC-104-382
R28,R37,R38	Fixed comp, 10 k, 10%, ¼ W	RC-104-310
R29,R31,R35, R39	Fixed comp, 22 k, 10%, ¼ W	RC-104-322
R30,R33,R34, R41,R42	Fixed comp, 100 k, 10%, ¼ W	RC-104-410
R32,R36,R40	Fixed comp, 10 Ω, 10%, ¼ W	RC-104-101
R43	Fixed comp, 470 Ω, 10%, ¼ W	RC-104-147
Transistors		
Q11	NPN, Si, RCA 36817	QB-000-001
Q12*,Q13*,Q14*, Q14*,Q15–17	NPN, Si, 2N3854A	QA-038-541
Q18	PNP, Si, 2N3644	QA-036-440


CIRCUIT A
+18V
R17
2.2
+18V
T11
6T
470
1000
8T
68
R18
470
CR11
IN34AS
C16
.01μf
R20
2.2M
R21
27K
R23
39K
Q13
Q12
C18
.01μf
R22
2.2K
R19
10K
C17
200
X11
J1
SWEEP
SAMPLE
IN
R11
100
R12
1K
C12
1000
R13
68K
R14
100
Q11
36817
R15
4.7
R43
470
X12
CIRCUIT B
R44
470
X13
CIRCUIT C
R45
470
X14
CIRCUIT D
R46
470
X15
CIRCUIT E
C32
C33
2
470
500
+18V
C34
C35
3
470
500
-18V
C27
8
470
A
C28
9
470
B
C29
10
470
C
C30
11
470
D
C31
12
470
E
SWITCHED
+18V

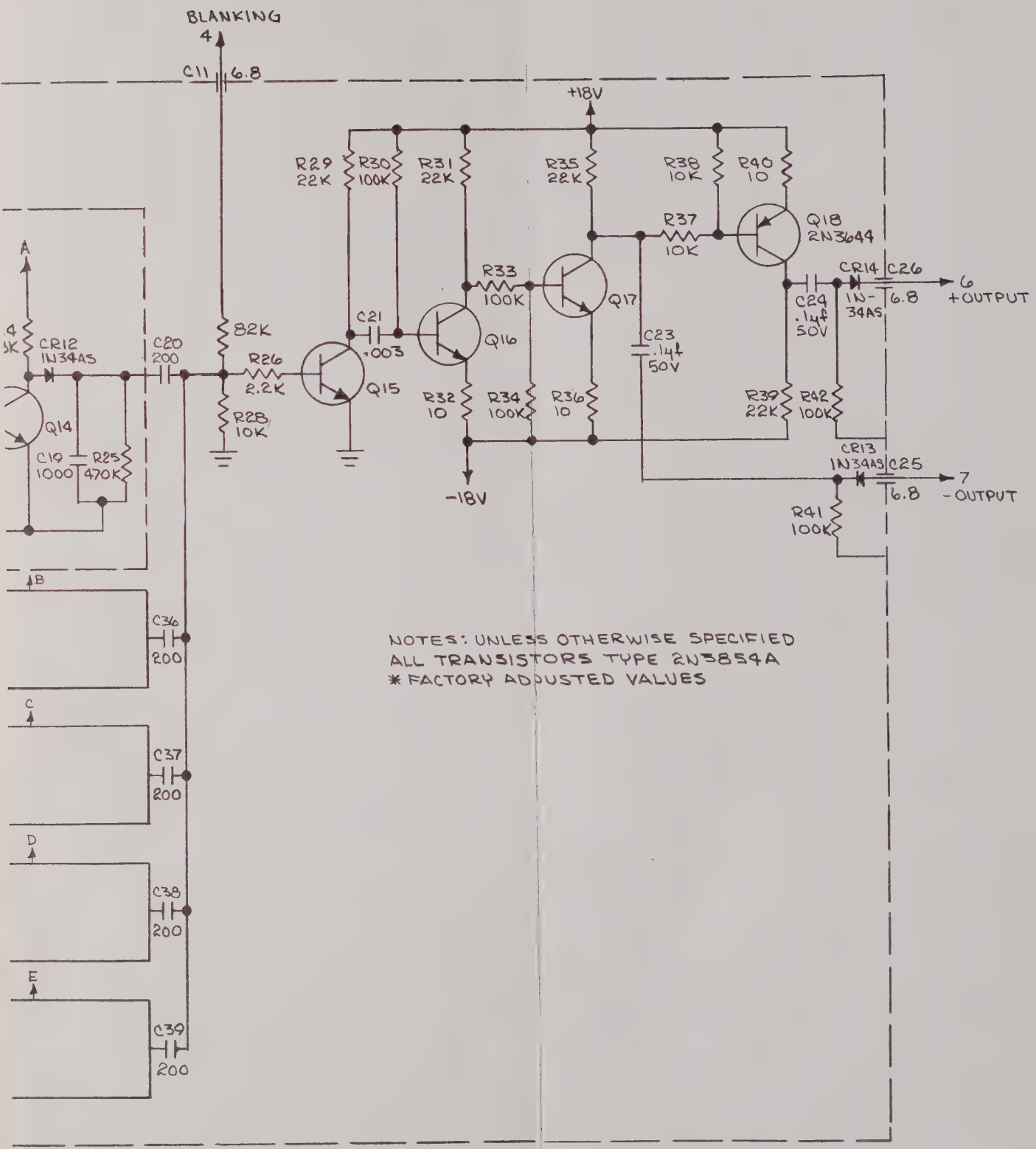


Figure 9-2. Module P13 schematic diagram.

MODULE P13 CON'T

Reference	Description	Part Number
Transformers		
T11	6¼ turns of no. 30 wire on LC-000-005	Not assigned
Miscellaneous		
Component socket		MC-000-001
Terminal	Teflon, 0.148 diam	HT-101-000
Terminal	Teflon, 0.185 diam	HT-102-000

MODULE P13 CON'T

Reference	Description	Part Number
Miscellaneous		
Pot mounting nut	Hex, size ¼ in.	HN-110-000
Connector	Receptacle, 50 Ω submin	JF-000-005

*Shaded area contains four circuits that are identical to circuit referenced with the asterisk.
**Indicates factory adjusted values.

SECTION 10
MODULE M12 PULSED CW

INTRODUCTION

Plug-in modules M12A, B, C and D provide crystal-controlled cw signals during the retrace portion of the associated sweep generator. The cw signals are keyed *on* for a period of approximately 400 μsec so that several may be added. Each may be positioned anywhere on the retrace. These signals are normally at rejection trap frequencies and are arranged to bypass the attenuator in the sweep generator. In this manner, a differential of sweep-vs-trap cw levels may be selected, providing exceptional resolution when adjusting these circuits. The M12A and M12B provide independently adjustable cw signals at sound, adjacent channel video or sound, or at frequencies for zero cross over on automatic fine tuning circuits.

The M12C provides two cw frequencies keyed *on* simultaneously. These are normally separated by the sound IF frequency and are within the bandpass of the associated IF amplifiers. (U.S. standard crystals are at 41.5 and 46.0 MHz or 4.5 MHz at second detector; European standard crystals at 34.5 and 39.0 MHz or 5.5 MHz.) At the second detector they mix, providing the difference frequency or the correct sound IF. The sound trap may be nulled or the sound IFs peaked, using signal injection through the video IF stages. The M12D is identical to the M12C, except that an output stage is provided so that the feature may be used without an M12A.

SPECIFICATIONS

Frequency	30.0 to 50.0 MHz.
Accuracy	0.005% of crystal frequency.
Output Amplitude	1 volt (75 ohm).
Pulse Width	Approximately 400 μsec.
Pulse Position	Anywhere on retrace portion.
Leakage (pulse off time)	At least −40 db.

CIRCUIT DESCRIPTION

The following circuit description is common to all four modules. The M12B and D do not use both sets of multivibrators, and the M12B and C do not use the output amplifier.

The block diagram in Figure 10-1 indicates an electrical relationship between the various circuits of the M12 modules. The differences between the M12A, B, C and D are clearly indicated. The pulse generator produces a dc pulse which is connected to the PIN driver stages. The PIN driver stages switch *on* the PIN diode switches during the pulse interval. This gates the RF output from the crystal oscillator to the output connector. The amplitude and position of the cw pulses are controlled by the **LEVEL** and **POSITION** controls.

Pulse Generators

The purpose of the pulse generators is to produce an 18-volt pulse to be used for gating on the crystal oscillator output during the retrace period of the sweep generator.

This is accomplished by two monostable multivibrator circuits Q2/Q3 and Q4/Q5. These circuits supply an 18-volt pulse at the emitter of Q6. The position of the pulse can be varied by **POSITION** control R6. This control is internal and the module cover must be removed to make the adjustment. (See the Calibration Section.) The amplitude of the pulse is adjusted by the **OUTPUT LEVEL** control R14. This control sets the amount of base drive to the PIN driver transistors.

Crystal Oscillator

The crystal oscillator consists of transistor circuit Q9 and Q12. This oscillator is a crystal-controlled Colpitts type with the crystal oscillating in the series-resonant mode. Feedback is provided by Q9, and tuning is accomplished by transformer T1. The RF output is loop coupled to the PIN diode switch. B+ for the oscillators is supplied through feedthru C22 pin 5 of the module base.

PIN Drivers

The purpose of the PIN drivers is to supply a pulse of current to the PIN diode switches during pulse *on* time and to reverse bias the PIN diodes during pulse *off* time.

The PIN drivers consist of transistor circuits Q9, Q10 and Q13. Transistors Q8 and Q13 control PIN diodes CR7 and CR8, respectively. Transistor Q10 controls the PIN diode in

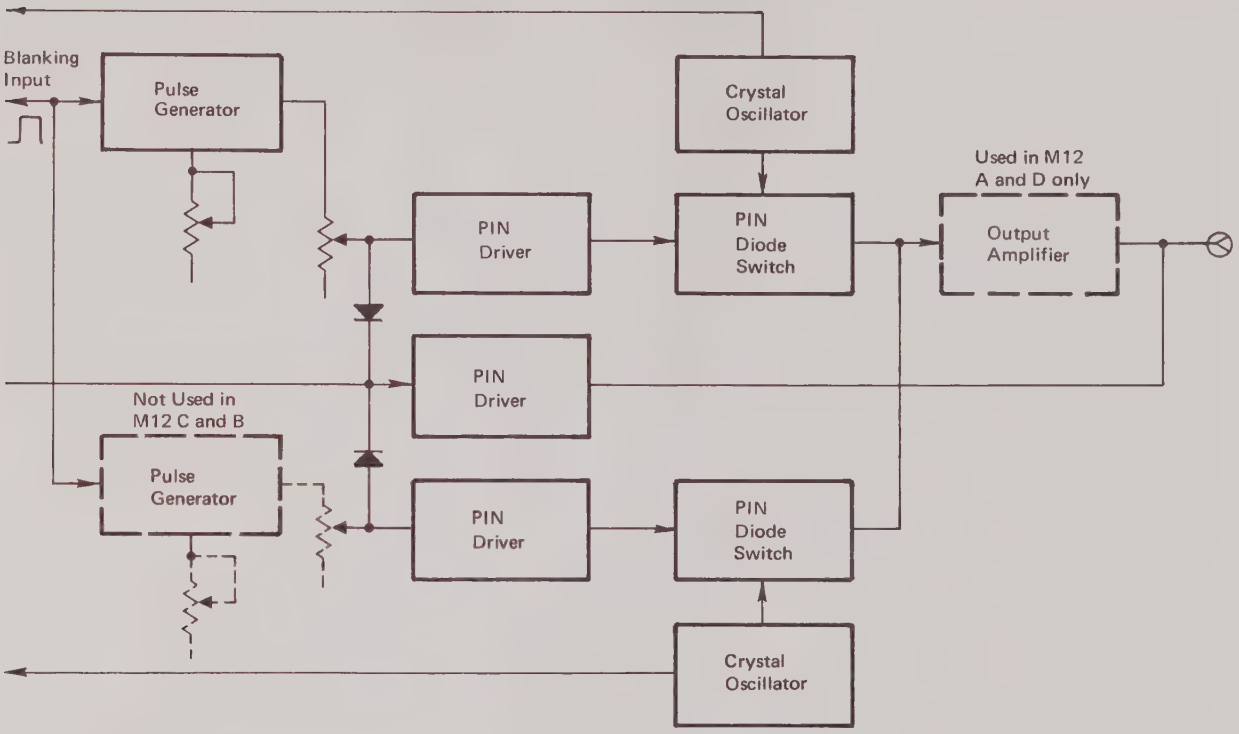


Figure 10-1. Module M12 block diagram.

the instrument RF attenuator. This transistor is used only in the M12A and M12D.

These transistors are switched on by the pulses supplied by the pulse generators. When the transistors are conducting, the PIN diodes are forward biased from the B– supply through the 1.5-k resistor in the emitter circuit. In the remaining time, the PIN diodes are reverse biased by the 10-k resistors R19 and R26 in the collector circuits.

PIN Diode Switches

PIN diodes CR7 and CR8 provide a switching element for the RF output of the crystal oscillator. The PIN diodes represent a low resistance when forward biased by the pulse of current from the PIN drivers. This allows the entire output of the crystal oscillator to appear at the base of Q9 or the output connector. When the PIN drivers are in the nonconducting stage, the PIN diodes are reverse biased and appear as a very large resistor. This large resistor forms a voltage divider with R22, providing at least 40-db of signal attenuation. An additional PIN diode is located in the instrument's RF attenuator. This diode is controlled by PIN driver Q10 and provides additional isolation.

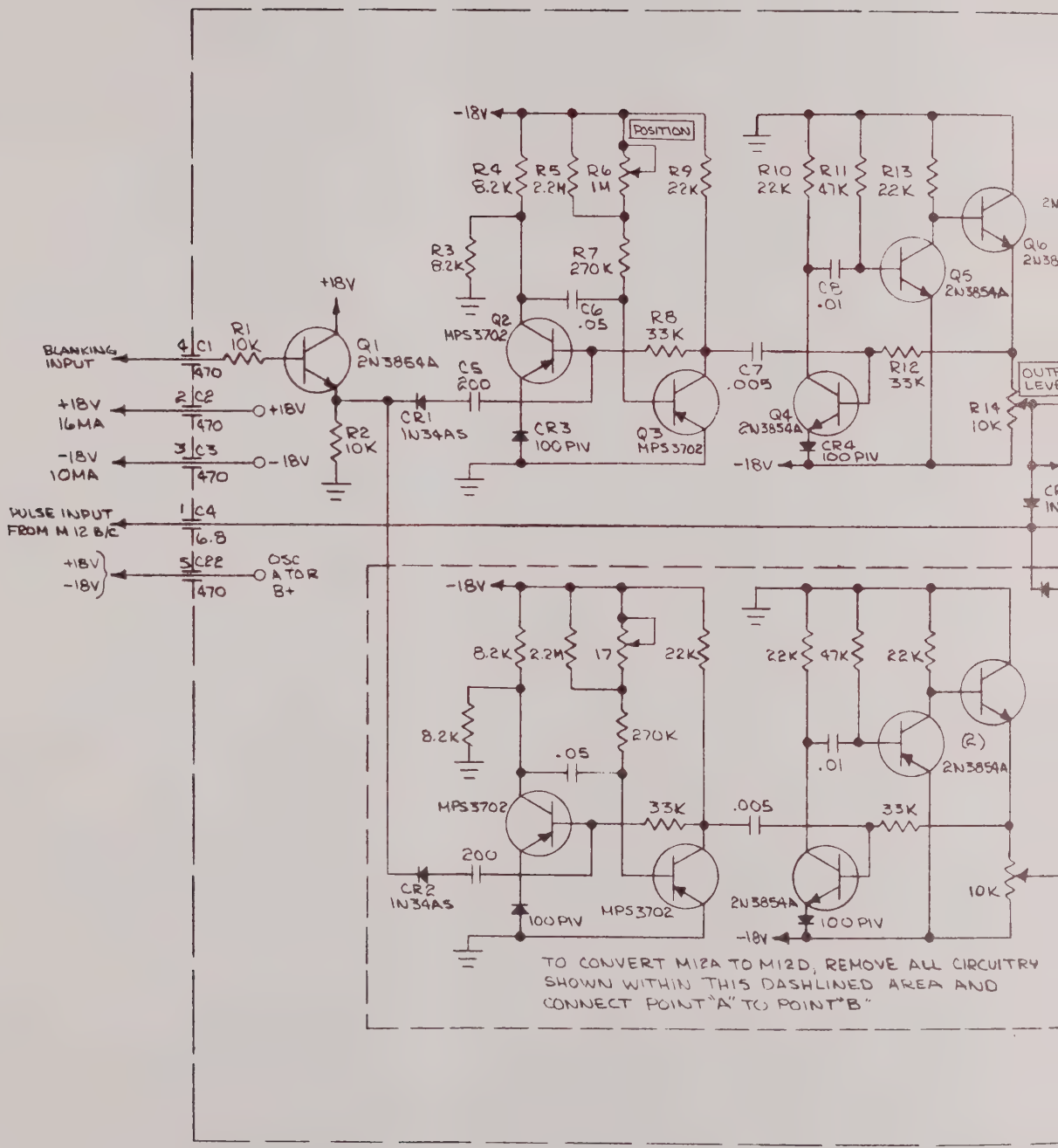
RF Output Amplifier (M12A and M12D only)

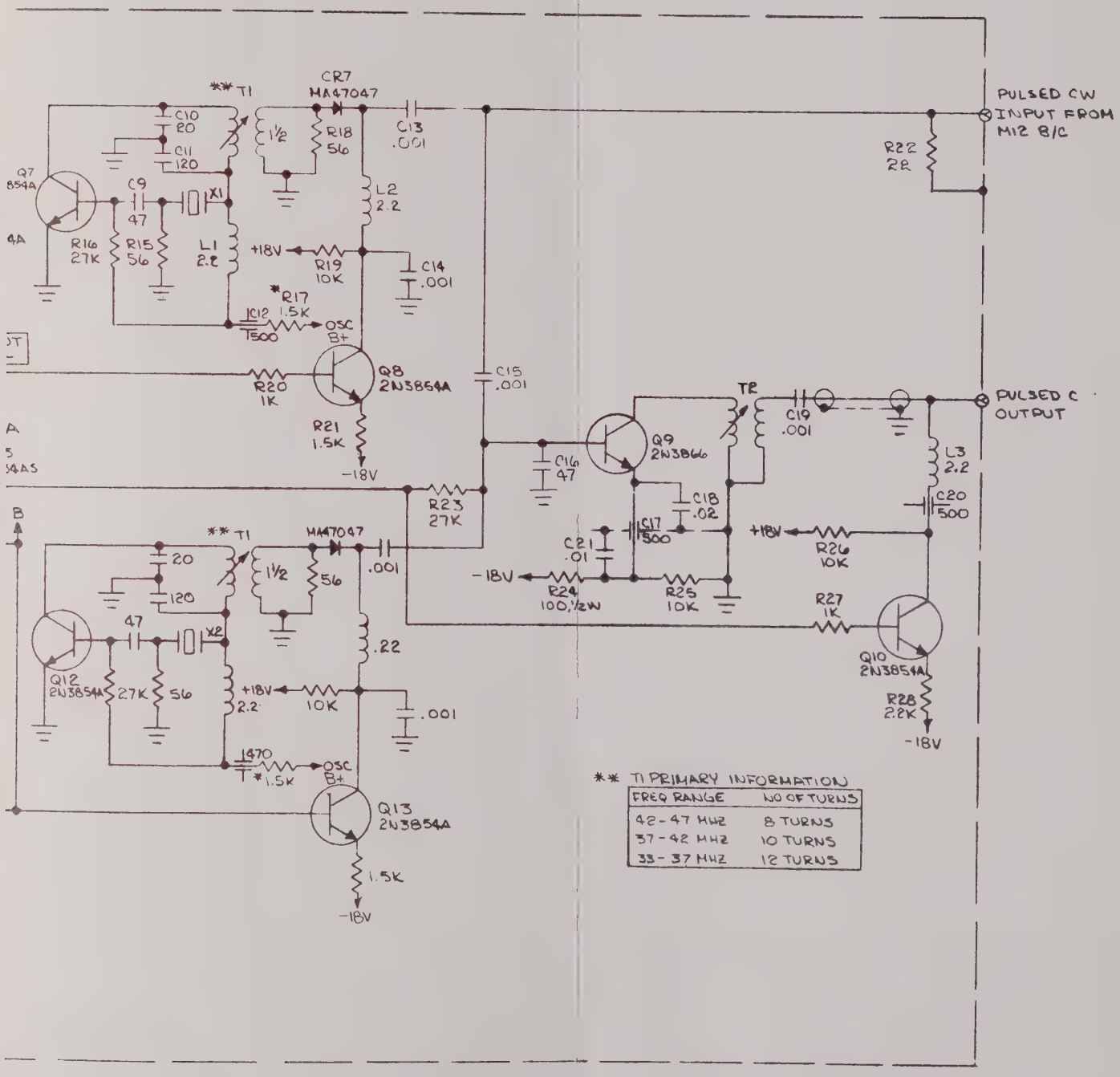
The pulsed cw from the PIN diode switches is applied to the base of Q9. Transistor Q9 and its associated circuitry provide a minimum of 1 volt rms output. Broad bandwidth is obtained by bifilar output transformer T2. The base of Q9 is returned to the output of **OUTPUT LEVEL** control R14 to provide a means of controlling the pulse cw output level.

MAINTENANCE

Troubleshooting

This troubleshooting chart should be used only after a


-18V
POSITION
R4 8.2K
R5 2.2M
R6 1M
R9 22K
R10 22K
R11 47K
R13 22K
R3 8.2K
R7 270K
C6 .05
C8 .01
Q6 2N38
Q5 2N3854A
+18V
BLANKING INPUT
4 C1
R1 10K
Q1 2N3864A
Q2 MPS3702
R8 33K
C7 .005
R12 33K
OUTP LEVE
C5 200
R14 10K
+18V 16MA
2 C2
+18V
470
CR1 1N34AS
CR3 100 PIV
Q3 MPS3702
Q4 2N3854A
CR4 100 PIV
-18V 10MA
3 C3
-18V
470
R2 10K
PULSE INPUT FROM M 12 B/C
1 C4
6.8
+18V -18V
5 C22
OSC ATOR B+
470
-18V
8.2K
2.2M
17
22K
22K
47K
22K
8.2K
270K
.05
.01
(R)
2N3854A
MPS3702
33K
.005
33K
200
CR2 1N34AS
100 PIV
MPS3702
2N3854A
100 PIV
10K
-18V
TO CONVERT M12A TO M12D, REMOVE ALL CIRCUITRY SHOWN WITHIN THIS DASHLINED AREA AND CONNECT POINT "A" TO POINT "B"



** T1 PRIMARY INFORMATION

FREQ RANGE	NO OF TURNS
42-47 MHz	8 TURNS
37-42 MHz	10 TURNS
33-37 MHz	12 TURNS

Figure 10-2. Module M12A and M12D schematic diagram.

trouble has been localized to the M12 module. Localizing a fault can be accomplished by using the power supply diagram, module wiring diagram, and the basic instrument maintenance section.

M12 TROUBLESHOOTING CHART

Symptom	Possible Trouble	Solution
No cw pulse.	Level and/or position control maladjusted.	See Calibration Section.
	Defective RF amplifier transistor Q9.	Replace.
	Defective PIN driver Q10.	Replace.
	Defective PIN diode in RF attenuator.	Replace.
One cw pulse.	Level and/or position controls maladjusted.	See Calibration Section.
	Defective crystal oscillator transistor.	Replace.
	Defective PIN diode CR7 or CR8.	Replace.
	Defective PIN driver Q8 or Q13.	Replace.
	Defective pulse generator transistors Q1, Q2, Q3, Q4, Q5 or Q6.	Replace.

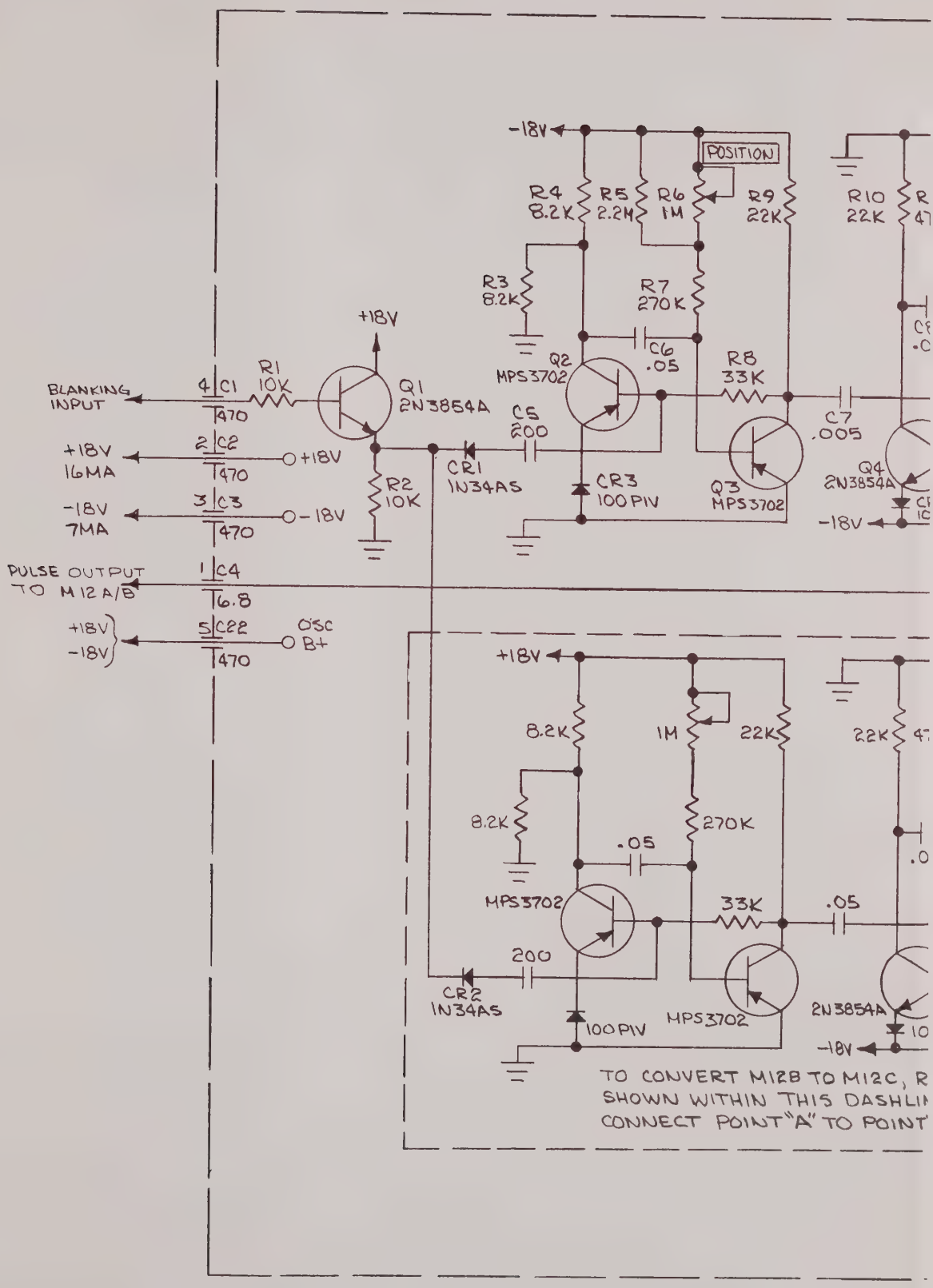
MODULE M12 PARTS LIST

Reference	Description	Part Number
Diodes		
CR1,CR2, CR5,CR6	Ge, point contact, 1N34A5	DG-100-341
CR3,[1] CR4[2]	Si, junction, 100 PIV 750 mA	DR-000-001
CR7[2]	Si, PIN	DP-000-040
Capacitors		
C1,C19,C20	Ceramic feedthru, 470 pF, ±20%, 500 V	CF-101-147
C2[1]	Ceramic disc, 200 pF, ±20%, 1 kV	CD-102-120
C3[1]	Ceramic disc, 0.05 μF, ±20%, 50 V	CD-103-350
C4[1]	Ceramic disc, 0.005 μF, ±20%, 1 kV	CD-102-250
C5[1]	Ceramic disc, 0.01 μF, ±20%, 1 kV	CD-103-310
C6,[2] C14[3]	Ceramic disc, 47pF, ±5%, 1 kV	CD-101-047
C7[2]	Ceramic disc, 20 pF, ±5%, 1 kV	CD-101-020
C8[2]	Ceramic disc, 120 pF, ±20%, 1 kV	CD-102-112
C9,[2] C15,C18	Ceramic feedthru, 500 pF, ±20%, 250 V	CF-104-150
C10,[2] C11,C12 C13,C17	Ceramic disc, 0.001 μF, ±20%, 1 kV	CD-102-210
C16[3]	Ceramic disc, 0.02 μF, ±20%, 50 V	CD-103-320
C21	Ceramic feedthru, 6.8 pF, ±10%, 500 V	CF-102-R68
Crystals		
X1[2]	At customer-specified frequencies	WX-000-331

MODULE M12 CON'T

Reference	Description	Part Number
Connectors		
J1[3]	Jack, receptacle, 75 Ω, submin	JF-000-004
J2	Jack, receptacle, 50 Ω, submin	JF-000-005
Inductors		
L1,[2] L2,[2] L3[3]	Fixed, molded, 2.2 μH, ±10%	LA-001R22
Resistors		
R1,R2,R20[2] R25,[3] R28,[3]	Fixed comp, 10 k, ±10%, ¼ W	RC-104-310
R3,[1] R4[1]	Fixed comp, 8.2 k, ±10%, ¼ W	RC-104-282
R5[1]	Fixed comp, 2.2 M, ±10%, ¼ W	RC-104-522
R6[1]	Variable carb, 1M, ±30%, 1/8 W	RP-112-510
R7[1]	Fixed comp, 270 k, ±10%, ¼ W	RC-104-427
R8,[1] R10,[1] R13[1]	Fixed comp, 22k, ±10%, ¼ W	RC-104-322
R9,[1] R12[1] R11[1,4]	Fixed comp, 33 k, ±10%, ¼ W	RC-104-333
R14[1]	Variable carb, 10 k, ±30%, ¼ W	RP-105-310
R15,[2] R23[3]	Fixed comp, 27 k, ±10%, ¼ W	RC-104-327
R16,[2] R21[2]	Fixed comp, 56Ω, ±10%, ¼ W	RC-104-056
R17,[2] R27[3]	Fixed comp, 2.2 k, ±10%, ¼ W	RC-104-222
R18,[2] R26[3]	Fixed comp, 1 k, ±10%, ¼ W	RC-104-210
R19[2]	Fixed comp, 1.5 k, ±10%, 1 W	RC-104-215
R22[3]	Fixed comp 22 Ω, ±10%, ¼ W	RC-104-022
R24	Fixed comp, 100 Ω, ±10%, ½ W	RC-106-110
Transistors		
Q1,Q4,[1] Q5[1] Q6,[1] Q7,Q8[1] Q10[3]	NPN, Si, 2N3854A	QA-038-541
Q2,[1] Q3[1]	PNP, Si, Motorola MPS3702	QB-000-009
Q9[3]	NPN, Si, 2N3866	QA-038-660
Transformers		
T1-HI	Coil form LB-003-000, 8, 1 turns no. 30 wire	Not assigned
T1-LO	Coil form LB-003-000, 12, 1 turns, no. 30 wire	Not assigned
T2[3]	Coil form LB-003-000, 8, 8 turns, no. 30 wire, bifilar wound	Not assigned
Miscellaneous		500
RF cable	500 Ω submin, RF 174/U	WC-101-740
Terminal	Teflon cloverleaf, 0.148 diam	HT-101-000
Terminal	Teflon cloverleaf, 0.185 diam	HT-102-000
Slug	Inductor tuning no. 10-32td	LC-000-002

[1] Components of two similar circuits in M12A, M12B.
[2] Components of two similar circuits.
[3] Components are not in M12B and M12C.
[4] Factory adjusted part.


-18V
POSITION
R4 8.2K
R5 2.2M
R6 1M
R9 22K
R10 22K
R3 8.2K
R7 270K
C6 .05
+18V
R1 10K
Q1 2N3854A
Q2 MPS3702
R8 33K
C7 .005
BLANKING INPUT
4 C1 470
C5 200
CR1 1N34AS
CR3 100 PIV
Q3 MPS3702
Q4 2N3854A
+18V 16MA
2 C2 470
+18V
R2 10K
-18V 7MA
3 C3 470
-18V
PULSE OUTPUT TO M12A/B
1 C4 6.8
+18V -18V
5 C22 470
OSC B+
8.2K
1M
22K
270K
.05
MPS3702
33K
200
CR2 1N34AS
100 PIV
MPS3702
2N3854A
TO CONVERT M12B TO M12C, R
SHOWN WITHIN THIS DASHLI
CONNECT POINT "A" TO POINT

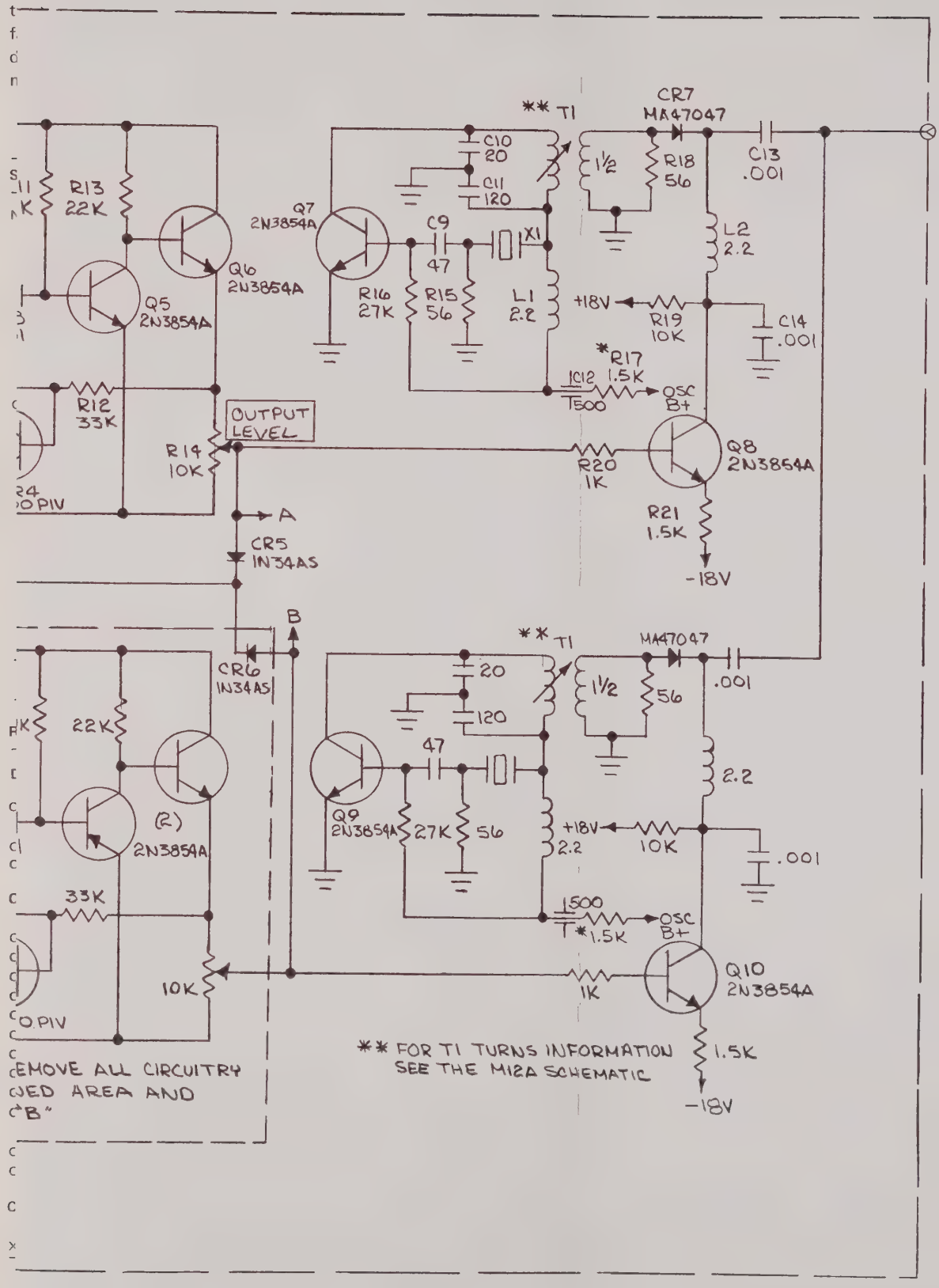


Figure 10-3. Module M12B and M12C schematic diagram.

SECTION 11
MODULE M16 CRYSTAL-CONTROLLED CW SOURCE

INTRODUCTION

Module M16 is a plug-in module used in a variety of Wavetek sweep and marker generators. It also finds uses as a general-purpose crystal-controlled signal source for incorporation into a variety of test systems. It features a moderately high RF output voltage and provisions for a dc controlled RF output adjustment with a 30-db range.

SPECIFICATIONS

Output Frequency	Single frequency between 37–48 MHz.
Frequency Accuracy	0.005%.
RF Output	3 V peak into 50 Ω.
RF Output Connector	Amphenol Series 27, 50-Ω jack.
Output Adjustment Range	30 db typical (25 db min).
Power Requirements	+18 V at 8 mA.
	−18 V at 25 mA.

CIRCUIT DESCRIPTION

The circuit consists of a crystal oscillator stage (Q1 and its associated parts) and a buffer/amplifier stage (Q2 and its associated parts).

The crystal oscillator is a Colpitts type with the crystals operating in the series-resonant mode. The buffer/amplifier stage is a common-emitter type with a bifilar wound wideband output transformer.

ADJUSTMENT

The crystal oscillator circuit is adjusted by tuning T1 for minimum current at pin 2. The secondary of T1 is then adjusted by positioning its winding to produce a maximum 3-volt output from a 50-ohm RF detector, connected to the RF output of the module. This is done when pin 6 is at ground potential. Tighter coupling of T1 secondary will produce more output but will restrict the range of the RF output control. T2 is a wideband transformer and requires no adjustment.

MAINTENANCE

Troubleshooting

Because of the simplicity of this module, a complete visual inspection is a logical first step. Check for good solder connections, burnt, discolored or physically damaged parts, etc. Output transistor Q2 should feel warm to the touch. A hot or cold temperature indicates a malfunction of the output stage. Current readings at pin 2 and 3 can be helpful in isolating troubles that are not apparent by visual inspection. No dip in current at pin 2 while tuning T1 indicates the crystal oscillator stage is not operating. Improper current at pin 3 indicates trouble in the buffer/amplifier stage. This current should vary from 4 to 25 mA when the output control is varied from −18 to 0 volts.

MODULE M16 REPLACEMENT PARTS LIST

Reference	Description	Part Number
Capacitors		
C1	Ceramic disc, 47 pF	CD-104-047
C2	Ceramic disc, 20 pF	CD-101-020
C3	Ceramic disc, 120 pF	CD-102-112
C4,C6	Feedthru, 500 pF	CF-104-150
C5	Ceramic disc, 0.001 μF	CD-102-210
C7,C8 C9,C10	Ceramic disc, 0.005 μF	CD-103-250
C11,C12	Feedthru, 470 pF	CF-101-147
Connectors		
J1	Jack	JF-000-005
Crystals		
X1	Quartz	XX-000-331
Inductors		
L1,L2,L3	Fixed, 2.2 μH	LA-001-R22
T1	Variable	Not assigned
T2	Variable	LB-001-108
Resistors		
R1	Fixed, 56 Ω, 1 W	RC-104-056
R2,R5	Fixed, 27 k	RC-104-327
R3	Fixed, 1 k	RC-104-210
R4	Fixed, 100 Ω	RC-104-110
R6	Fixed, 10 k	RC-104-310
R7	Fixed, 330 Ω, 1 W	RC-107-133

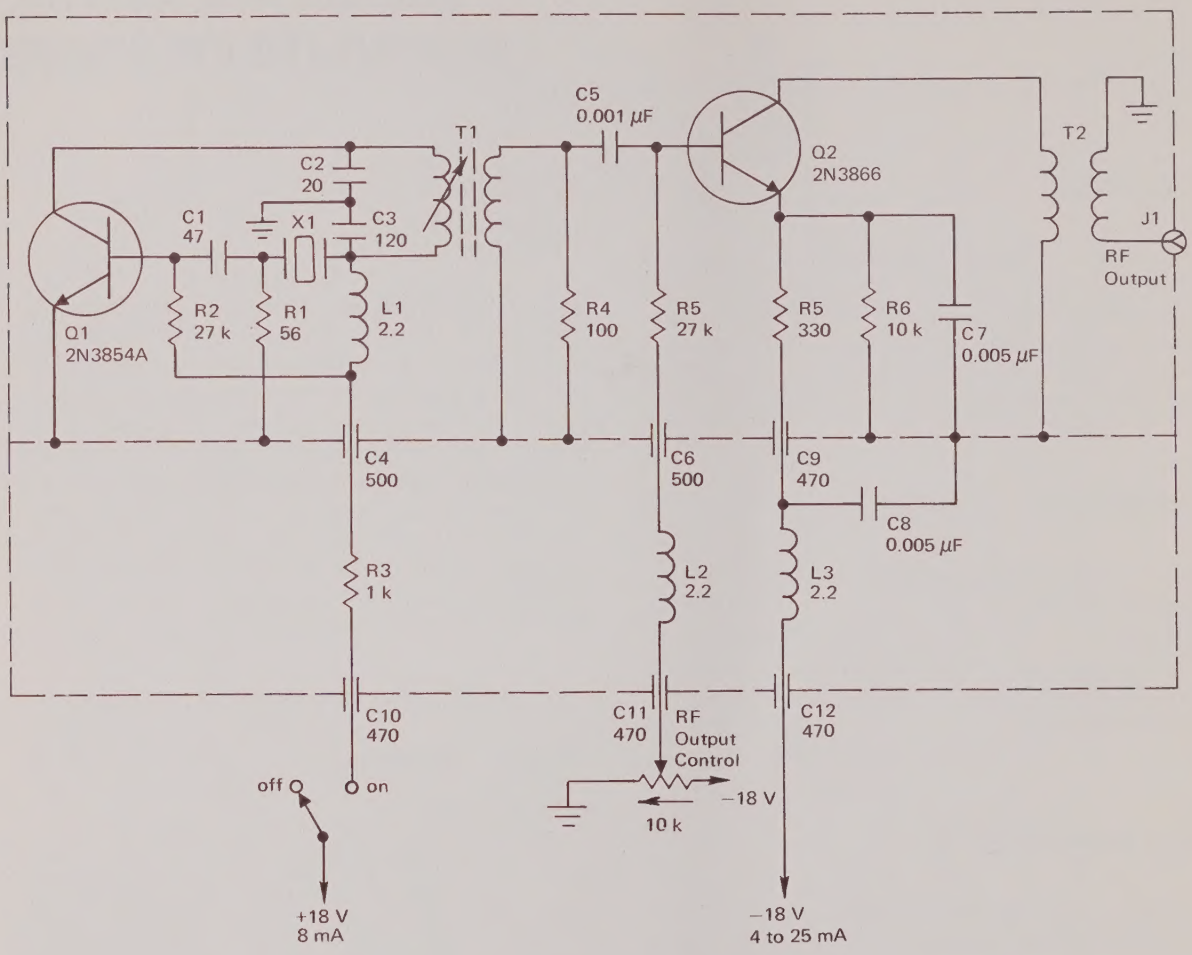


Figure 11-1. Module M16 schematic diagram.

Reference	Description	Part Number
Transistors		
Q1	NPN, 2N3854A	QA-038-541
Q2	NPN, 2N3866	QA-038-660

Reference	Description	Part Number
Miscellaneous		
Terminal	Teflon, small	HT-101-000
Terminal	Teflon, large	HT-102-000

MP MASTER
MA30890